

The Proportional Migration (PM) Selective Fishery Model

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0.1 Introduction

Complex models are frequently used by biologists to predict mortalities associated with proposed fishery regimes. For over ten years the States of Washington and Oregon have used a model (currently known as the Fishery Regulation Assessment Model: FRAM) to predict coho salmon mortalities associated with salmon fisheries along the west coast of the U.S. and Canada. A fundamental assumption of FRAM is that all fish from a stock are assumed to be available to all fisheries that harvest that stock within each time period. This is known as a "single pool" model. Although this model has been deemed adequate for many years, the "single pool" assumption is a gross simplification of the actual situation and is unlikely to be robust to major alterations in current fishing patterns.

One such potential alteration is the proposed implementation of a comprehensive program to fin clip juvenile hatchery coho and subsequently selectively harvest those fin-clipped fish as adults. Since the goal of this program is to differentially harvest marked and unmarked coho, it is essential for evaluation to be able to predict the ultimate disposition of fish that escape the selective fisheries. This, of course, requires the ability to predict the stock-specific migration patterns of coho. Unfortunately, migration parameters are difficult to measure directly and generally must be inferred from fishery data.

The Proportional Migration Selective Fishery Model (PM) is an attempt to simulate the effects of selective fisheries on coho mortalities (landed and unlanded) and coded wire tag (CWT) recoveries using relatively simple migration assumptions. The stock-specific movement of fish is a function of the predicted proportional abundance among fisheries within a time step. The mortalities of marked and unmarked coho in both the selective and non-selective fisheries are calculated using the equations developed by Lawson and Sampson (in press).

The PM model is designed to accommodate any number of fisheries and stocks. For the analyses reported in this paper, the stocks and fisheries modelled were identical to the final fishery and stock categories input for the interagency Mixed Stock Model (MSM) to estimate the 1991 coho CWT production expansion factors (PEFs).

In order to demonstrate capabilities of the PM model we simulated the selective fisheries and mass marking program proposed by WDFW and ODFW (Feb. 13, 1996). While the PM can be used to evaluate a variety of management questions, the model's capabilities are demonstrated by the following analyses:

1. Estimate the impact of the proposed selective fisheries on stocks and fisheries, including changes in the magnitude and distribution of stock mortalities and catches;
2. Evaluate the impact of the proposed selective fisheries on tribal/non-tribal allocation; and
3. Evaluate the impact of the proposed selective fisheries on the accuracy and bias of PEF estimates. The current proposal specifies an increase in coded wire tagging to offset complications in PEF estimation. However, the large decrease in CWT returns in selective fisheries may substantially hinder PEF estimation.

Clearly this is not intended to be a complete evaluation of the WDFW and ODFW proposal. Instead it is hoped that this description and demonstration of the PM model will be valuable to managers as they consider the appropriate analytical tools for evaluating future annual and long-term management plans that incorporate mass marking and selective fishing.

0.2 Input Files

The input files consist of:

- A matrix of estimated CWT recoveries by stock and fishery, followed by a listing of catches and CWT sample rates by fishery. This file is specific to a return year and represents actual CWT and catch estimates for the year. It has an identical format to that used by the MSM to estimate PEFs.
- A file of stock information (Table 1) including:
 - Stock Name
 - Production Expansion Factor (as computed by MSM)
 - Percent Wild - from the final preseason input file to the Fishery Regulation Assessment Model (FRAM)
 - Proportion of the hatchery component that is not mass marked.¹
The model assumes that equal numbers of marked and unmarked hatchery production are CWT. This models the double index tagging

¹A parameter used as part of the user defined selective fishery specification.

(DIT) scenario described in the Pacific Salmon Commission report on Selective Fisheries Evaluation (ASFEC 1995).

- ◊ Modeled base exploitation rate - the total stock-specific exploitation rate of the model fisheries in the stock reconstruction stage (not all fisheries are included in the PM).
- ◊ Target exploitation rate - the desired stock-specific exploitation rate in the fishery simulation stage of the PM.
- ◊ Total base exploitation rate - the stock-specific exploitation rate across all fisheries in the stock reconstruction stage.
- ◊ Proportion of terminal catch caught by tribal fishers - this is the seed value for the allocation analysis.
- ◊ Stock group ID - the numeric code linking the model stocks to management stocks.

- A file of fishery information (Table 2) including:

- ◊ Fishery name - this usually includes gear and month concatenated to the fishery name. For example NWVI.troll.6 is Northwest Vancouver Island troll fishery in June.
- ◊ Time step - the order in which fisheries occur. There are six time steps currently being used that are defined as follows: 1 -> January - May; 2 -> June; 3 -> July; 4 -> August; 5-> September; 6 -> October - December.
- ◊ Fishery harvest rate - fishery harvest rates are not well known. However, we evaluated the sensitivity of the PM model to these parameters and determined that the model gave similar results under a wide range of harvest rates [Lawson and Comstock, 1995].
- ◊ Type of fishery (troll, sport, net)
- ◊ Selective fishery flag (Y or N)¹
- ◊ Fishery controls - specifies how the PM models fisheries. There are two types of fishery controls:
 - ◊ Catch
 - ◊ Effort

These fishery controls can be set such that the simulated fisheries remain the same as in the non-selective fishery scenario, or

they can be set to a user specified constant value. For effort, a specified value is used to scale original effort. For example, E1.2 implies that the model should apply 1.2 times as much effort in a fishery. Values specified for catch are used directly. That is, specifying C2000 as a fishery control causes the model to simulate a catch of 2000 fish. Alternatively, specifying C alone keeps new catches equal to the base catch.

- Proportion of the catch that is caught by tribal fishers - used as a seed value in the allocation analysis.
- A file of selective fishery parameters that includes:
 - For each type of fishery (troll, net, sport)
 - release mortality rate¹
 - mark recognition rate¹
 - unmarked recognition rate¹
 - dropoff probability¹
 - dropoff mortality rate¹
 - Mass marking mortality¹

0.3 Overview of Model Operation

The operation of the model consists of two principal stages, the stock reconstruction stage and the fishery simulation stage.

0.3.1 Stock Reconstruction Stage

The first step in simulation of the effects of selective fisheries consists of calculating stock-specific catches, mortalities and abundances for the base fishery scenario. Model catch calculations by stock component, fishery, and time sequence are done in three steps: (1) CWT recoveries are multiplied by the PEF, (2) these products are summed across stocks within a fishery and divided by the reported catch for that fishery, and (3) the products from step 1 are multiplied by the scalars from step 2. This insures that the base catch equals the reported catch for that fishery. Base mortality is calculated by dividing the catch by the catch fraction appropriate for the fishery type. Stock component specific abundance by fishery and time step is calculated by dividing the catch by harvest rate times the catch fraction appropriate for that fishery stratum.

The PM model differs from other models in that there are no initial populations (i.e., total December Age 2 recruits) from which fishery mortalities are subtracted with remainder being escapement. In the PM model, populations are independently calculated for each stock, fishery and time period stratum.

0.3.2 Fishery Simulation Stage

Fishery simulation consists of estimating the catch, mortalities, and CWT recoveries that would occur under the specified selective fishery scenario. Changes in mortality relative to the base are passed on to the next time period. This causes abundances, computed initially in the stock reconstruction stage, to change as the fishery simulation proceeds. The total changes in mortalities after the final time step are added to the base escapements to calculate the new escapements.

0.4 Details of Model Operation

0.4.1 Reconstruction Stage.

0.4.1.1 Stock Reconstruction Stage.

The stock reconstruction stage begins by computing the initial catch of each stock $Initial_C_{ijt}$ in each time step/fishery stratum.:

$$Initial_C_{ijt} = PEF_i * CWT_{ijt} \quad (0.1)$$

where,

i = stock index

j = fishery index

t = time index

The $Initial_C_{ijt}$ are then scaled so that when summed within a fishery they equal the reported catch for that fishery. Reported catch is the catch enumerated by fisheries monitoring systems.

$$C_{ijt} = \frac{\sum_i Initial_catch_{ijt}}{Reported_catch_{jt}} Initial_catch_{ijt} \quad (0.2)$$

The total population of a stock component available to the fishery in each time step P_{ijt} is then estimated from the computed catch, the fishery specific harvest rate, and the catch fraction.

$$P_{ijt} = \frac{C_{ijt}}{(HR_{jt} * cat_frac_j)} \quad (0.3)$$

HR_{jt} is the fishery harvest rate in time period t and cat_frac_j is the fraction of the total mortalities that are landed catch and is defined as:

$$cat_frac_j = \frac{(1 - drop_prob_j)}{(1 - drop_prob_j) + drop_prob_j * drop_mort_j} \quad (0.4)$$

Base mortality by stock M_{ijt} is computed by dividing the base catch by the catch fraction:

$$M_{ijt} = C_{ijt}/cat_frac_j \quad (0.5)$$

Catches and mortalities are summed over stocks to get fishery totals. The total mortalities for each fishery and time is then:

$$M_{jt} = \sum_i M_{ijt} \quad (0.6)$$

Catch for each fishery and time step is:

$$C_{jt} = \sum_i C_{ijt} \quad (0.7)$$

To calculate base total initial abundances and final escapements we used two exploitation rate values that are input to the model. The first of these is the modelled base exploitation rate $Modelled_E_i$. This is the stock-specific exploitation rate of the fisheries represented in the PM. The second is the total base exploitation rate $Total_E_i$. This value is the stock-specific exploitation rate across all fisheries that harvest that stock. If the PM contains all of the fisheries that harvest a particular stock these two exploitation rates will be identical². If not, the total base exploitation rate is greater than the modelled base exploitation rate and a “terminal fishery” is created that has mortalities equal to the difference between the two exploitation rates.

To calculate the total initial abundance by stock, the stock-specific mortalities, summed across all fisheries in the PM model ($M_{i..} = \sum_{jt} M_{ijt}$), are divided by the stock-specific modelled base exploitation rate ($A_i = \frac{M_{i..}}{Modelled_E_i}$). To calculate total mortalities (from both modelled and non-modelled fisheries), the

²It is necessary to use both of these values since the PM does not contain all of the fisheries that harvest west coast coho. Recall from above that the fishery specification comes from the PEF estimation model, which is unable to incorporate the catch in many terminal fisheries.

stock-specific model mortalities are divided by the ratio of the modelled base exploitation rate and the total base exploitation rate ($Total_M_i = M_{i..} \frac{Modeled_E_i}{Total_E_i}$). The “terminal mortalities” ($Term_M_i$) are calculated as the difference between the total mortalities and the model mortalities ($Term_M_i = Total_M_i - M_{i..}$). Escapement is calculated as the difference between total initial abundance and the total mortalities ($Esc_i = A_i - Total_M_i$).

To calculate the initial parameter values for the fishery simulation stage the base statistics described above are partitioned into stock components using proportions defined by percent wild and percent hatchery unmarked parameters specified in the stock input file:

$$\begin{aligned} prop_M &= (1 - \%wild_i) * (1 - \%unmarked_i) \\ prop_U &= (1 - \%wild_i) * \%unmarked_i \\ prop_W &= \%wild_i \end{aligned} \quad (0.8)$$

where,

M = Marked hatchery

U = Unmarked hatchery

W = Wild

For example, catch by stock is partitioned into each stock component C_{kijt} :

$$\begin{aligned} C_{Mijt} &= C_{ijt} * prop_M \\ C_{Uijt} &= C_{ijt} * prop_U \\ C_{Wijt} &= C_{ijt} * prop_W \end{aligned} \quad (0.9)$$

0.4.1.2 Fishery reconstruction stage

The fishery reconstruction stage calculates the probability of mortality and the base effort using the Lawson and Sampson methodology. This method begins by developing the probability of mortality given that a fish is hooked:

$$Prob(mort | encountered) = (1 - drop_prob_j) + drop_prob_j * drop_mort_j \quad (0.10)$$

The above probability is then used to model the relationship between fishing effort and mortality rate:

$$mort_rate \rightarrow 1 - e^{(-Prob(mort|encountered)*effort_j)} \quad (0.11)$$

The number of mortalities is the above mortality rate times the population size:

$$M_{jt} = P_{jt} * mort_rate \quad (0.12)$$

Since it is not possible to solve for the value of *effort_j*, that will result in the reconstructed *M_{jt}*, iteration is used until an acceptable value is located.

0.4.2 Fishery Simulation

The fishery simulation proceeds chronologically by time step. Fisheries within a time step are simulated in an independent fashion. Therefore, ordering of the fisheries has no effect on the outcome. Catch (*C'*) and mortality (*M'*) are modelled under specified selective fishery scenarios and will change due to 3 mechanisms:

1. Any change in mortality in previous time periods will cause abundance to change in the current time period;
2. In selective fisheries, catch and mortality are computed differently for marked and unmarked components of the population; and
3. The management control for any fishery (selective or non-selective) can be changed by the user.

The methods developed by Lawson and Sampson (above) are used to compute catch and mortality in each fishery.

0.4.3 Stock Migration and Distribution of Changes in Catch and Mortalities.

As the simulation progresses over time steps, changes in fishery mortality relative to the base must be reflected in the fish available to fisheries in succeeding time steps. The distribution of these changes in mortalities requires assumptions about fish migratory behavior. In the PM model, the sums of the changes in stock-specific mortalities from all previous time steps are distributed to the next time step based on the stock's proportional initial distribution of abundance among fisheries in that time period.

0.4.3.1 Computation of Catch and Mortality

Catch and mortality are computed independently for each component (marked, unmarked or wild) of each stock. The Lawson-Sampson equations are used to compute probability of marked mortality ($Prob(\text{marked_mort} \mid \text{encountered})$) and unmarked mortality ($Prob(\text{unmarked_mort} \mid \text{encountered})$) given that a fish is hooked. These equations are expanded from the $Prob(\text{mort} \mid \text{encountered})$ equations in the stock reconstruction stage to account for error in recognizing marked and unmarked fish.

$$\begin{aligned} Prob(\text{marked_mort} \mid \text{encountered}) = & \quad (0.13) \\ & (1 - \text{drop_prob}) * \text{mark_recognition_rate} + \\ & (1 - \text{drop_prob}) * (1 - \text{mark_recognition_rate}) * \\ & \text{release_mort_rate} + \\ & \text{drop_prob} * \text{drop_mort} \end{aligned}$$

$$\begin{aligned} Prob(\text{Un_marked_mort} \mid \text{encountered}) = & \quad (0.14) \\ & (1 - \text{drop_prob}) * \\ & \text{un_mark_recognition_rate} * \\ & \text{release_mort_rate} + \\ & (1 - \text{drop_prob}) * \\ & (1 - \text{un_mark_recognition_rate}) + \\ & \text{drop_prob} * \text{drop_mort} \end{aligned}$$

The number of new mortalities is the new abundance times the probability of mortality,

$$\begin{aligned} M'_{Mijt} &= P_{Mijt} * Prob(\text{marked_mort}) \quad (0.15) \\ M'_{Uijt} &= P_{Uijt} * Prob(\text{unmarked_mort}) \\ M'_{Wijt} &= P_{Wijt} * Prob(\text{unmarked_mort}) \end{aligned}$$

and the new catch is the new mortality times the catch fraction:

$$\begin{aligned}
 C'_{Mijt} &= M_{Mijt} * \text{Marked_catch_fraction} \\
 C'_{Uijt} &= M_{Uijt} * \text{Unmarked_catch_fraction} \\
 C'_{Wijt} &= M_{Wijt} * \text{Unmarked_catch_fraction}
 \end{aligned} \tag{0.16}$$

The catch fractions above are simple products of probabilities. `Marked_catch_fraction` is defined as :

$$\text{Marked_catch_fraction} = p1/(p1 + p2 + p3) \tag{0.17}$$

where,

- $p1$ = Probability that a marked fish is caught and is correctly identified;
- $p2$ = Probability that a marked fish is caught but is misidentified as unmarked and dies upon release;
- $p3$ = Probability that a marked fish drops off and dies as a result.

Unmarked .catch .fraction is defined as:

$$\text{Unmarked_catch_fraction} = p4/(p4 + p5 + p6) \tag{0.18}$$

where,

- $p4$ = Probability that an unmarked fish is caught and is misidentified as marked;
- $p5$ = Probability that an unmarked fish is caught and is correctly identified as unmarked but dies upon release;
- $p6$ = Probability that an unmarked fish drops off and dies as a result.

0.4.3.2 Computation of Change in Mortality

The change in mortality is the difference between base and new mortality in each fishery and time step:

$$\begin{aligned}
 \Delta M_{Mijt} &= M_{Mijt} - M'_{Mijt} \\
 \Delta M_{Uijt} &= M_{Uijt} - M'_{Uijt} \\
 \Delta M_{Wijt} &= M_{Wijt} - M'_{Wijt}
 \end{aligned} \tag{0.19}$$

0.4.3.3 Modifying abundance in next time step

After processing all fisheries within a time step, the total stock-specific change in mortalities across all fisheries for each stock component in that time step are summed:

$$\Delta M_{ki,t} = \sum_j \Delta M_{kijt} \quad (0.20)$$

The running total for each stock is the summation of the changes in time steps 0 to t :

$$\Delta M_{ki}^T = \sum_{t'=0}^t \Delta M_{ki,t'} \quad (0.21)$$

The summed changes in mortality must then be distributed to the fisheries in the next time step. To apportion these, the base abundances are used to compute the fraction ($F_{ij(t+1)}$) of the stock available to the fishery in the next time step³:

$$F_{ij(t+1)} = P_{ij(t+1)} / \sum_j P_{i..(t+1)} \quad (0.22)$$

The population available to each fishery in the next time step is the original population available to that fishery plus the running total of changes in mortality from all previous time steps times the fraction of the stock originally available to each fishery in the next time step:

$$P_{kij(t+1)} = P_{kij(t+1)} + \Delta M_{ki}^T * F_{ij(t+1)} \quad (0.23)$$

0.4.3.4 Calculating “terminal” mortalities

Total mortalities by stock component are limited in the simulation stage by the inputted target exploitation rate, which is defined as the total mortalities divided by the initial abundance:

$$Target_E_i = M_{i..}/P_{i..} \quad (0.24)$$

Stocks from the same production area (identified by the stock group ID in the stock input file) are controlled by the same target exploitation rate. The

³For stocks without a terminal fishery (i.e., Oregon and California) escapement is considered a fishery in the last time step. This prevents all of the change in mortality from the previous time steps being allocated to “dip-in” fisheries (e.g., OCN caught in Columbia River net fisheries).

controlling stock component can be either wild (designated as W.## in the stock input file) or the hatchery (designated as H.##). The non-controlling stocks within a production area are designated by a N.##.

If the total mortality of the controlling stock component summed across all model fisheries is less than that specified by the target exploitation rate, a “terminal” fishery is created. The size of the new terminal fishery is calculated in several steps:

1. The new terminal run size by stock component ($term_run_{ki}$) is calculated as the sum of base escapement, base terminal mortality, and the change in mortality resulting from the forward running of the model (ie. $term_run_{ki} = Esc_i + Term_M_{ki} + \Delta M_{ki..}^T$). For marked stock components (i.e., $k = M$) $Esc_i + Term_M_{ki}$ is multiplied by $(1 - massmarkmort)$ to simulate mass marking mortality;
2. Next the modelled fishery exploitation rate is calculated:

$$New_E_{ki} = \frac{M'_{ki..}}{M'_{ki..} + term_run_{ki}} \quad (0.25)$$

Where, $M'_{ki..}$ is the summed mortality for stock component ki in the modelled fisheries;

3. Next the allowable exploitation rate for the terminal fisheries is calculated as the target exploitation rate minus the new exploitation rate ($\Delta ER_{ki} = Target_E_{ki} - New_E_{ki}$);
4. The new terminal harvest rate is;

$$term_HR_i = \frac{\Delta ER_{ki} * (M'_{ki..} + term_run_{ki})}{term_run_{ki}} \quad (0.26)$$

5. This terminal harvest rate, calculated from the controlling stock component is then applied to the other stock components from the production area to produce “terminal mortalities” for those stock components; and

$$term_mort_{ki} = term_run_i * term_HR_i \quad (0.27)$$

Terminal catches are then terminal mortalities less those fish that were lost due to dropoff mortality. Unfortunately the unmodelled terminal fisheries will be a combination of net and sport fisheries, having different dropoff and dropoff mortality probabilities. Compromise values of $dropprob = 0.3$ and $dropmort =$

0.4 were used for all terminal fisheries. Applying these values to the catch fraction formula of :

$$\frac{(1 - dropprob)}{(1 - dropprob) + dropprob * dropmort} \quad (0.28)$$

yields:

$$term_catch_i = term_mort_i * 0.854 \quad (0.29)$$

Thus, the final exploitation rates of the non-controlling stock components within a production area may or may not be equal to the target exploitation rate for that production area. If the exploitation rate from the model fisheries is greater than the target exploitation rate, the fishery requires modification to reduce the exploitation rate on the applicable stocks.

This technique of creating a “terminal” fishery to catch any additional fish necessary to reach the target exploitation rate is much simpler than coding an iterative process that changes some set of fisheries until the target exploitation rate is met for all stocks. If the catch in these fisheries is large for all stocks (i.e., the model exploitation rates are low) the model fisheries are modified to increase their catch in the simulation stage.

0.4.4 Calculating new CWT recoveries

New CWT recoveries are a function of stock component-specific catches and PEFs. For this analysis it is assumed that the DIT groups have identical numbers of CWT fish and that no wild fish are tagged; the unmarked and tagged fish represent the wild fish. CWT recoveries are not calculated for the model “terminal” fisheries. The new CWT recoveries by stock component and fishery are calculated using the following equations:

$$\begin{aligned} CWT'_{Mijt} &= C'_{Mijt}/PEF_{Mi} \\ CWT'_{Uijt} &= C'_{Uijt}/PEF_{Ui} \end{aligned} \quad (0.30)$$

where,

$$\begin{aligned} PEF_{Mi} &= PEF_i * (1 - \%wild_i) * (1 - \%unmarked_i) \\ PEF_{Ui} &= PEF_i - PEF_{Mi} \end{aligned} \quad (0.31)$$

0.5 Demonstration Analyses

To demonstrate the capabilities of the PM model we performed three analyses of the WDFW and ODFW selective fishery proposal (Feb. 13, 1996):

1. Estimated the impact of the proposed selective fisheries on stocks and fisheries, including changes in the magnitude and distribution of stock mortalities and catches;
2. Estimated the impact of the proposed selective fisheries on tribal/non-tribal allocation; and
3. Estimated the impact of the proposed selective fisheries on the accuracy and bias of PEF estimates.

0.5.1 Input Data

0.5.1.1 Catch and CWT Recoveries

This input file contains CWT recoveries by stock and fishery, catch by fishery, and CWT sampling rate by fishery. The stock and fishery specification is identical to that used by the Coho Cohort Analysis Committee for the 1991 coho cohort reconstruction. The time period specification is the authors and is designed to capture the major periods of fish migration and fishery operation.

0.5.1.2 Stocks

This input file (Table 1) describes each stock in the PM model. Percent of hatchery fish unmarked values reflect the WDFW and ODFW selective fishery proposal (Feb. 13, 1996). Target exploitation rate values reflect a hypothetical management scenario for 1998. For most stocks, the target rate is identical to the base rate. The target for the Oregon Coastal Natural (OCN) stock was lowered dramatically to simulate the present conservation needs of this stock. The target exploitation rates for the Willapa and Columbia River stocks were increased to simulate a desire to harvest hatchery stocks at a high exploitation rate. The proportions of tribal catch in the terminal areas are seed values for the allocation analysis. They are not meant to represent actual proportions. All other parameter values are meant to approximate actual values for 1991.

0.5.1.3 Fisheries

This input file (Table 2) describes the fisheries in the PM model. The selective fishery designation reflects the WDFW and ODFW proposal. All fisheries were modelled as effort fisheries. The effort values for the selective fisheries generally were higher than the base, with the exception of Oregon fisheries. The Oregon fisheries were reduced to meet the low target exploitation rate for OCN. The effort values for all other fisheries were left equal to the base management scenario for 1998. The proportions of tribal catch for each fishery are seed values for the allocation analysis. They are not meant to represent actual proportions (unless they equal 0 or 1).

0.5.2 Methods

0.5.2.1 Stocks and Fisheries

The impact of the proposed selective fisheries on stocks was evaluated by calculating the fishery-specific exploitation rate for each stock component:

$$\text{Fishery_}E_{kijt} = M'_{kijt} / \text{sum}M'_{ki..} + Esc'_{ki} \quad (0.32)$$

This matrix of exploitation rates captures both the difference in the patterns of mortality between marked and unmarked fish and the redistribution of mortalities due to selective fisheries relative to the base non-selective fishery scenario.

0.5.2.2 Tribal/Non-tribal Allocation

Selective fisheries will result in a redistribution of harvest. Acceptability of any fishery regime, including those conducted with selective fisheries in place, will be judged in part on the accomplishment of Indian treaty harvest sharing requirement (e.g., U.S. v Washington, and U.S. v Oregon). Accomplishment of these sharing obligations will be judged in the annual management planning forum, for example during the spring of 1998 in the PFMC and North of Falcon processes.

To analyze the potential for maintaining tribal:non-tribal harvest sharing with the implementation of the WDFW/ODFW selective fishery proposal, an optimization program was used to adjust tribal/non-tribal catch in individual fisheries. These adjustments attempt to achieve an equal tribal/non-tribal catch

of Puget Sound, Washington coastal and Columbia River stocks.⁴ There were several assumed constraints on fisheries:

1. Some fisheries are entirely tribal or entirely non-tribal. The optimization program does not modify allocation within these fisheries.
2. The program modified the allocation of Washington fisheries and Oregon Columbia River fisheries only.
3. We did not change catch or effort in any fisheries. We lacked information needed to assess the political feasibility of changing various fisheries to achieve allocation requirements.

The proportion of the catch that was allocated to tribal fishers was not constrained in those fisheries that had both tribal and non-tribal components. This could be modified in future analyses.

0.5.2.3 PEF Estimation

The accuracy and precision of PEF estimates will likely be affected by selective fisheries in three ways:

1. Due to the differential harvesting of marked and unmarked fish, all fish may no longer be represented by CWT groups;
2. Due to the inability to recover tags of unmarked fish in selective fisheries, it may be harder to differentiate the CWT recovery patterns of different stocks; and
3. Because PEFs for marked and unmarked fish will have to be estimated separately, a new parameter will have to be estimated - the mark ratio of the catch. This parameter may introduce bias and will increase the variance of the estimates relative to the non-selective fishery situation.

The first problem can likely be minimized by creating CWT index groups for each component of the stock. In other words, if a stock has both marked and unmarked components, two CWT groups would be created, one marked and one unmarked. This is known as double index tagging (DIT; see ASFEC 1995 for a more complete discussion). In some cases, both a marked and unmarked

⁴The objective function is the sum of squared differences between the proportion of catch that was treaty and the proportion of catch that was non-treaty for all Washington stocks including the Columbia River stocks.

CWT group might be created even if the stock was completely marked or unmarked. In these instances, the DIT groups would provide the data required to evaluate the efficiency of the selective fisheries at differentially exploiting marked and unmarked fish of that stock. The second problem remains; there are currently no feasible methods for recovering CWTs from unmarked fish in selective fisheries. Data to estimate the mark ratio in the landed catch should be easily obtained from the current sampling programs, but it may be biased and it will be estimated with error. Selective fisheries should not systematically affect other aspects of sampling for CWTs.

In this analysis, DIT groups were created by splitting the base PEF into marked and unmarked PEFs based on the assumption that the DIT groups would have equal numbers of CWT fish (see equation 0.31). In addition, the "percent hatchery unmarked" input data for those stocks that were assumed to be either 100 percent marked or unmarked was adjusted to create enough fish for a DIT group. This was accomplished by the following equations:

$$\%hatchery_Unmarked_i = \frac{1}{(PEF_i * (1 - \%Unmarked_i))} \quad (0.33)$$

for stocks that are 100% marked, and

$$\%hatchery_Unmarked_i = 1 - \frac{1}{(PEF_i * (1 - \%Unmarked_i))} \quad (0.34)$$

for stocks that are 100% unmarked.

DIT groups were created for all stocks harvested in the selective fisheries with the following exceptions: (1) the stock was 100 percent wild, or (2) the PEF was so small that DIT groups with equal numbers of CWT fish could not be created.

The lack of recovery capability in selective fisheries was simulated by calculating the CWT recoveries in all fisheries from landed catch only. The mark ratio of the landed catch was calculated from the model output of catch by stock component.

Base PEFs were estimated using MSM and marked and unmarked CWT matrices obtained by running the PM model with base effort levels and no selective fisheries. To assess the impacts of selective fisheries, marked and unmarked CWT matrices were obtained by running the PM model with the efforts and selective fishery designations specified by the selective fishery input files.

To simulate the error associated with the additional parameter required to estimate PEFs with selective fisheries (mark ratio of the catch), 1,000 new marked and unmarked CWT matrices were generated with variation in the estimates of catch associated with each matrix. The distribution of the error was modelled by a hypergeometric distribution defined by the CWT sampling rate specified in the PM model input file. The mean of the 1,000 samples was compared to the base PEF or each stock component.

0.6 Model Outputs

The PM model currently produces a set of electronic files and a set of tables. Both types of output are discussed below.

0.6.1 Electronic Files

The model currently produces the following output files:

- A summary file which includes:
 - Estimates of catch and mortality, by stock and fishery.
 - Estimates of escapement by stock.
 - Estimates of changes in catch, mortalities and escapement between the specified selective fisheries scenario and the base.
 - Estimates of fishery specific and total exploitation rates.
- Three MSM input files that contain the estimated CWTs recovered from the fisheries as specified by the fishery input file. One file contains the CWT recoveries from marked fish, the second file contains the CWT recoveries from unmarked fish, and the third files contains the sum of the recoveries from both marked and unmarked fish. These can be used with MSM to measure the effects of selective fisheries on PEF estimation. CWT recoveries from unmarked components of a stock result from DIT. Recall that DIT specifies that a proportion of hatchery fish are CWT but not mass marked. CWT recoveries for marked stocks are taken in catch from both selective and non-selective fisheries. CWT for unmarked stocks are recovered primarily in catch from non-selective fisheries. A relatively small number of recoveries from unmarked stocks are also recovered in selective fisheries due to misidentification of unmarked fish by fishers.

- Four auxiliary files that contain statistics required for independent analyses:
 - Runprefix.base.popstats - contains the base initial population abundances, total mortalities, and escapements by stock component.
 - Runprefix.new.popstats - contains simulated initial population abundances, total mortalities, and escapements by stock component.
 - Runprefix.termmort - contains the simulated mortalities by stock component that occur in the “terminal” fisheries.
 - Runprefix.termcatch - contains the simulated catches by stock component that occur in the “terminal” fisheries.

0.6.2 Tables

In addition, several tables were created that summarize the output data. Additional summary tables can be created as necessary.

1. Table 3 is a fishery table that contains:
 - (a) Fishery name;
 - (b) The base effort - the weighted average of the base efforts across time steps within a fishery (weights = catch) ;
 - (c) The new effort - the weighted average of the efforts specified for (or resulting from) simulation across time steps within a fishery (weights = catch) ;
 - (d) Base Catch - the average of the base catches across time steps within a fishery ; and
 - (e) New Catch - the average of the catches specified for (or resulting from) simulation across time steps within a fishery .
2. Table 4 is a stock table that contains:
 - (a) Stock name;
 - (b) Percent wild - the proportion of the total stock abundance that is wild;
 - (c) Percent unmarked - the proportion of the hatchery abundance that is unmarked;

- (d) Delta catch - the change in catch, relative to the base and across all fisheries, for the stock;
 - (e) Percent delta catch - the change in catch expressed as a percentage of the base catch;
 - (f) Delta wild mortality - the change in mortalities, relative to the base and across all fisheries, for the wild component of the stock; and
 - (g) Percent delta wild mortalities - the change in wild mortalities expressed as a percentage of the base wild mortalities.
3. Table 5 is a second stock summary table that contains:
- (a) Stock name;
 - (b) New wild escapement - the simulated wild escapement;
 - (c) Percent delta wild escapement - the change in wild escapement expressed as a percentage of the base wild escapement;
 - (d) Total marked ER - the total exploitation rate (total mortalities divided by initial abundance) of the marked fish;
 - (e) Total unmarked ER - the total exploitation rate (total mortalities divided by initial abundance) of the unmarked fish; and
 - (f) Total wild ER - the total exploitation rate (total mortalities divided by initial abundance) of the wild fish.
4. Table 6 contains the exploitation rates for each stock and fishery, summed across time steps. Exploitaton rates from the simulation stage are displayed for each stock component. The base fishery specific exploitation rates are displayed for comparison. The fishery specific eploitation rates are additive and the differences among the stock components and between the stock components and the base demonstrates the ability of selective fisheries to redistribute mortalities.
5. Table 7 contains the stock results of the allocation analysis. Displayed are the proportions of hatchery, wild and total for each Puget Sound and Washington coastal stock that is caught by treaty fishers.
6. Table 8 contains the fishery results from the allocation analysis. The file contains the fishery name with the time period appended, the total catch across all stocks, and the proportion of the catch caught by treaty fishers. The "terminal fisheries created by the model are displayed last with the stock name as the fishery name.

7. Table 9 is a PEF analysis summary table that contains:
 - (a) Stock name;
 - (b) Mark type - marked or unmarked;
 - (c) True PEF - This is the set of marked and unmarked PEFs calculated by the Mixed Stock Model (MSM) using a CWT recovery matrix produced by the PM model. The input files for the PM model run are specified to reproduce the base mortalities (i.e., no selective fisheries or mark mortality and base efforts); and
 - (d) Simulated PEF - simulated PEFs are calculated by the MSM from CWT and catch matrices produced by the simulation stage of the PM model. The values displayed are the means of the PEFs from the , specified number of iterations. The differences between the "true" and "simulated" PEFs estimates the deterioration in accuracy of PEF estimation as a result of selective fisheries.

Table 1: Summary of Stock Input Parameters, Run = run05.out

Stock	PEF	% Wild	% Hatchery Unmarked	Modeled Base ER	Total Target ER	Total Base ER	Stock Group
Georgia Strait-Mainland	58.73	20	97.87	.70	W.75	.75	0
Georgia Strait-Vancouver Island	5.86	20	78.67	.70	W.75	.75	1
North Coast British Columbia	116.84	60	97.86	.70	W.75	.75	2
NW Vancouver Island	137.83	60	98.19	.70	W.75	.75	3
Queen Charlotte Island	112.26	80	100.00	.70	W.75	.75	4
Trans Boundary	286.99	80	100.00	.70	W.75	.75	5
South AK In	25.11	80	100.00	.70	W.75	.75	6
South AK Out	42.43	80	100.00	.70	W.75	.75	7
North AK In	27.15	50	100.00	.70	W.75	.75	8
North AK Out	124.78	80	100.00	.70	W.75	.75	9
Nooksack/Samish	21.35	15	94.49	.71	H.73	.73	10
Bellingham Bay Heritage	1.18	0	100.00	.71	N.73	.73	10
Skagit Wild	12.23	100	100.00	.60	W.60	.60	11
Skagit Hatchery	2.81	0	35.59	.60	N.60	.6	11
Swinomish Channel	2.04	0	0.00	.60	N.60	.60	11
Stillaguamish/Snohomish	45.21	62	75.00	.70	W.73	.73	12
South Sound	31.91	21	3.97	.72	H.84	.84	13
Nisqually Hatchery	9.70	0	100.00	.72	N.84	.84	13
Quilcene Hatchery	6.38	0	84.33	.55	N.58	.58	14
Port Gamble Hatchery	53.50	0	0.00	.55	N.58	.58	14
Quilcene Bay Net Pens	8.25	0	87.88	.55	N.58	.58	14
Hood Canal Wild	41.53	100	100.00	.55	W.58	.58	14
George Adams Hatchery	3.90	0	25.64	.55	N.58	.58	14
JDF/Area 9/Dungeness/Elwha	234.92	55	0.95	.66	W.67	.67	15
Elwha Hatchery	7.25	0	100.00	.66	N.67	.67	15
Port Angeles Net Pens	1.00	0	0.00	.66	N.67	.67	15
Makah	3.61	5	100.00	.47	W.51	.51	16
Hoh	17.95	100	100.00	.47	W.62	.62	17
Quilayute	48.79	30	97.07	.55	W.55	.55	18
Queets	10.48	42	83.55	.75	W.75	.75	19
Quinault	13.73	45	86.76	.70	W.70	.70	20
Grays Harbor Wild	18.86	50	10.60	.72	W.72	.72	21
Grays Harbor Hatchery	1.30	0	0.00	.72	N.72	.72	21
Columbia River-Early	28.31	5	3.72	.80	H.90	.87	22
Columbia River-Late	39.51	5	2.66	.71	H.90	.81	23
Oregon Coast	23.49	33	6.35	.54	W.20	.54	24
Oregon Aqua-culture	29.40	0	3.40	.54	N.20	.54	24
California	25.63	20	95.12	.54	W.54	.54	25
Rogue	9.64	50	20.75	.54	W.20	.54	26
Chehalis Hatchery	9.31	0	10.74	.72	N.72	.72	21
Willapa	39.39	5	2.67	.75	H.80	.75	27

Table 2: Fishery Input File, run=run04

FISHERY	Seq	HR	Type	Sel	Mgt	Prop. treaty
ALL.AK.TROLL	1	.42	T	N	E	0
NBC.TROLL	1	.42	T	N	E	NA
NCBC.TROLL	1	.42	T	N	E	NA
SCBC.TROLL	1	.42	T	N	E	NA
NWVI.TROLL.6	2	.60	T	N	E	NA
NWVI.TROLL.7	3	.60	T	N	E	NA
NWVI.TROLL.8	4	.60	T	N	E	NA
NWVI.TROLL.9	5	.40	T	N	E	NA
SWVI.TROLL1.5&6	2	.40	T	N	E	NA
SWVI.TROLL1.7	3	.60	T	N	E	NA
SWVI.TROLL1.8	4	.60	T	N	E	NA
SWVI.TROLL1.9	5	.40	T	N	E	NA
GS.TROLL.6&7	3	.10	T	N	E	NA
GS.TROLL.8	4	.10	T	N	E	NA
GS.TROLL.9	5	.10	T	N	E	NA
GS.TROLL.10-12	6	.10	T	N	E	NA
NBC.NET	4	.10	N	N	E	NA
CBC.NET	4	.50	N	N	E	NA
JOHNSTONE.NET.7	3	.30	N	N	E	NA
JOHNSTONE.NET.8	4	.30	N	N	E	NA
JOHNSTONE.NET.9&10-12	5	.30	N	N	E	NA
GEORGIA.STRAIT.NET.8&9	5	.20	N	N	E	NA
GEORGIA.STRAIT.NET.10-12	6	.10	N	N	E	NA
JDF.NET6&7	3	.30	N	N	E	NA
JDF.NET.8	4	.30	N	N	E	NA
JDF.NET.9	5	.30	N	N	E	NA
JDF.SPORT.1-5	1	.05	S	N	E	NA
JDF.SPORT.6	2	.10	S	N	E	NA
JDF.SPORT.7	3	.10	S	N	E	NA
JDF.SPORT.8	4	.10	S	N	E	NA
JDF.SPORT.9	5	.10	S	N	E	NA
JDF.SPORT.10-12	6	.05	S	N	E	NA
WCVI.SPORT.7	3	.02	S	N	E	NA

FISHERY	Seq	HR	Type	Sel	Mgt	Prop. treaty
AREA.8.SPORT.8	4	.05	S	Y	E2	0
AREA.8.SPORT.9	5	.05	S	Y	E2	0
AREA.8.SPORT.10-12	6	.05	S	Y	E	0
AREA.9.SPORT.1-5	1	.05	S	Y	E	0
AREA.9.SPORT.6	2	.05	S	Y	E2	0
AREA.9.SPORT.7	3	.05	S	Y	E2	0
AREA.9.SPORT.8	4	.05	S	Y	E2	0
AREA.9.SPORT.9	5	.05	S	Y	E2	0
AREA.9.SPORT.10-12	6	.05	S	Y	E	0
AREA.10/11.SPORT.1-5	1	.05	S	Y	E	0
AREA.10/11.SPORT.6	2	.05	S	Y	E	0
AREA.10/11.SPORT.7	3	.05	S	Y	E	0
AREA.10/11.SPORT.8	4	.05	S	Y	E	0
AREA.10/11.SPORT.9	5	.05	S	Y	E	0
AREA.10/11.SPORT.10-12	6	.05	S	Y	E	0
QUILLAYUTE.RIVER.NET.8	4	.37	N	N	E	1
QUILLAYUTE.RIVER.NET.9	5	.37	N	N	E	1
QUILLAYUTE.RIVER.NET.10-12	6	.37	N	N	E	1
GRAYS.HARBOR.ESTUARY.NET.10-12	6	.37	N	N	E	.5
COLRIV.MOUTH.TROLL.8	4	.15	T	N	E	0
COLRIV.MOUTH.TROLL.9	5	.15	T	N	E	0
COLRIV.MOUTH.SPORT.6	2	.20	S	Y	E	0
COLRIV.MOUTH.SPORT.7	3	.20	S	Y	E	0
COLRIV.MOUTH.SPORT.8	4	.20	S	Y	E	0
COLRIV.MOUTH.SPORT.9	5	.20	S	Y	E	0
AREA.2.TROLL.7&8	4	.03	T	N	E	.4
AREA.2.TROLL.9	5	.03	T	N	E	.4
WA.AREA.2.SPORT.6	2	.15	S	Y	E3	0
WA.AREA.2.SPORT.7	3	.15	S	Y	E3	0
WA.AREA.2.SPORT.8	4	.15	S	Y	E3	0
WA.AREA.2.SPORT.9	5	.15	S	Y	E3	0
WA.AREA.3.TROLL.&.SPORT.7	3	.05	T	N	E	.3
WA.AREA.3.TROLL.&.SPORT.8	4	.05	T	N	E	.3
WA.AREA.3.TROLL.&.SPORT.9	5	.05	T	N	E	.3

FISHERY	Seq	HR	Type	Sel	Mgt	Prop. treaty
NORTHERN.GEORGIA.STRAIT.7	3	.30	S	N	E	NA
NORTHERN.GEORGIA.STRAIT.8	4	.30	S	N	E	NA
NORTHERN.GEORGIA.STRAIT.9	5	.30	S	N	E	NA
NORTHERN.GEORGIA.STRAIT.10-12	6	.20	S	N	E	NA
SOUTHERN.GEORGIA.STRAIT.1-5	1	.30	S	N	E	NA
SOUTHERN.GEORGIA.STRAIT.6	2	.30	S	N	E	NA
SOUTHERN.GEORGIA.STRAIT.7	3	.30	S	N	E	NA
SOUTHERN.GEORGIA.STRAIT.8	4	.30	S	N	E	NA
SOUTHERN.GEORGIA.STRAIT.9	5	.30	S	N	E	NA
SOUTHERN.GEORGIA.STRAIT.10-12	6	.20	S	N	E	NA
AK.115.NET	4	.70	N	N	E	0
ALL.AK.NET	4	.70	N	N	E	0
CALIF.KMZ.ALL.6	2	.20	T	Y	E	0
CALIF.KMZ.ALL.7	3	.20	T	Y	E	0
CALIF.KMZ.ALL.8	4	.20	T	Y	E	0
CALIF.KMZ.ALL.9	5	.20	T	Y	E	0
CALIF.FTB/SOCAL.ALL.1-5	1	.40	S	Y	E	0
CALIF.FTB/SOCAL.ALL.6	2	.40	S	Y	E	0
CALIF.FTB/SOCAL.ALL.7	3	.40	S	Y	E	0
CALIF.FTB/SOCAL.ALL.8	4	.40	S	Y	E	0
QUEETS.RIVER.NET.9	5	.50	N	N	E	1
QUEETS.RIVER.NET.10-12	6	.50	N	N	E	1
QUINAULT.RIVER.NET.8	4	.50	N	N	E	1
QUINAULT.RIVER.NET.9	5	.50	N	N	E	1
QUINAULT.RIVER.NET.10-12	6	.50	N	N	E	1
BROOKINGS.SPORT.6	2	.20	T	Y	E.65	0
BROOKINGS.SPORT.7	3	.20	T	Y	E.65	0
BROOKINGS.SPORT.8	4	.20	T	Y	E.65	0
BROOKINGS.SPORT.9	5	.20	T	Y	E.65	0
GRAYS.HARBOR.ESTUARY.SPORT.8	4	.20	S	Y	E2	0
GRAYS.HARBOR.ESTUARY.SPORT.9	5	.20	S	Y	E2	0
GRAYS.HARBOR.ESTUARY.SPORT.10-12	6	.20	S	Y	E	0
WILLAPA.BAY.NET.9	5	.20	N	N	E	0
WILLAPA.BAY.NET.10-12	6	.20	N	N	E	0

Table 3: Summary of Fishery Changes, run=run05

Fishery Group ¹	Base Effort	New Effort	Base Catch	New Catch
AK Troll	0.801	0.801	1719765	1719548
NBC Troll	0.801	0.801	982300	981943
NCBC Troll	0.801	0.801	58344	58307
SCBC Troll	0.801	0.801	47384	47239
NWVI Troll	1.309	1.307	664632	667643
SWVI Troll	1.321	1.318	1225298	1229244
GS Troll	0.151	0.151	11583	11683
NBC Net	0.179	0.179	196179	196142
CBC Net	1.373	1.373	54137	54139
Johnstone Net	0.639	0.639	63778	64668
Georgia Strait Net	0.201	0.202	7168	7164
JDF Net	0.639	0.639	180362	181190
JDF Sport	0.131	0.131	110492	111740
WCVI Sport	0.029	0.029	49847	50198
NK/Samish Marine Net	0.961	0.966	49685	50565
Skagit Mar & FW Net	0.934	0.956	3606	3722
STL/SNO Marine Net	0.953	0.953	59869	60371
AR 10 Net	1.373	1.373	145453	139904
Area 4B-5-6C Net	0.639	0.639	36468	36395
Area 5-6 Troll	0.073	0.073	5565	5538
Area 6/6A/7/7A Net	0.639	0.639	62001	63626
Area 5-6 Sport	0.320	0.628	192017	116156
Area 7 Sport	0.073	0.073	3953	350
Area 8 Sport	0.073	0.145	7659	5579
Area 9 Sport	0.073	0.141	20971	19922
Area 10/11 Sport	0.073	0.073	25696	16728
Quillayute River Net	0.850	0.850	4723	5070
Gray Harbor Estuary Net	0.850	0.850	47763	46565
Columbia River Mouth Troll	0.234	0.234	42992	45405
Columbia River Mouth Sport	0.320	0.320	114594	91743
Area 2 Troll	0.044	0.044	17774	18166
WA Area 2 Sport	0.233	0.699	88862	144529
WA Area 3 Troll & Sport	0.073	0.073	27019	27097
WA Area 4/4B Troll	0.234	0.234	78953	79659
WA Area 4 Sport	0.104	0.312	30529	27068
Columbia River Early & YB Net	3.385	3.385	168564	175138
Columbia River Late Net	3.385	3.385	240692	232593
Buoy 10 Sport	0.233	0.233	208659	178582
WA GH FW Net	0.953	0.953	77495	75829
Tillamook & Est Sport	0.320	0.207	33236	16676
Newport & Est Sport	0.320	0.208	85549	44030
Coos Bay & Est Sport	0.320	0.208	112739	60188
Tillamook Troll	0.519	0.337	90180	41011
Newport Troll	0.519	0.337	88702	44765
Coos Bay Troll	0.519	0.337	100980	54758

¹Effort values are summed over time periods. Catches are averaged.

Table 4: Summary of Stock Changes in Modeled Fisheries (Part I) , run=run05

Stock	% Wild	% Unmarked	Delta Catch	% Delta Catch	Delta Wild Mort.	% Delta Wild Mort.
Georgia Strait-Mainland	20	97.87	-32027	-3	-0	0
Georgia Strait-Vancouver Island	20	78.67	-1558	-1	-0	0
North Coast British Columbia	60	97.86	-613	0	-0	0
NW Vancouver Island	60	98.19	-329	0	-0	0
Queen Charlotte Island	80	100.00	0	0	0	0
Trans Boundary	80	100.00	-0	0	0	0
South AK In	80	100.00	-108	0	-0	0
South AK Out	80	100.00	0	0	0	0
North AK In	50	100.00	-0	0	-0	0
North AK Out	80	100.00	0	0	-0	0
Nooksack/Samish	15	94.49	-14430	-9	-1643	-6
Bellingham Bay Heritage	0	100.00	-94	-15	0	0
Skagit Wild	100	100.00	-2305	-8	0	0
Skagit Hatchery	0	35.59	133	5	0	0
Swinomish Channel	0	0.00	487	10	0	0
Stillaguamish/Snohomish	62	75.00	-11411	-4	-0	0
South Sound	21	3.97	-34593	-6	-11939	-8
Nisqually Hatchery	0	100.00	-1155	-14	0	0
Quilcene Hatchery	0	84.33	-737	-3	0	0
Port Gamble Hatchery	0	0.00	10281	11	0	0
Quilcene Bay Net Pens	0	87.88	-368	-3	0	0
Hood Canal Wild	100	100.00	-3882	-9	0	0
George Adams Hatchery	0	25.64	345	7	0	0
JDF/Area 9/Dungeness/Elwha	55	0.95	178	1	0	0
Elwha Hatchery	0	100.00	-59	-12	0	0
Port Angeles Net Pens	0	0.00	114	15	0	0
Makah	5	100.00	-2149	-7	-0	0
Hoh	100	100.00	-423	-6	0	0
Quilayute	30	97.07	-8383	-8	-0	0
Queets	42	83.55	-2461	-6	-0	0
Quinault	45	86.76	-4743	-6	0	0
Grays Harbor Wild	50	10.60	-1615	-1	0	0
Grays Harbor Hatchery	0	0.00	420	2	0	0
Columbia River-Early	5	3.72	-29360	-4	-3548	-9
Columbia River-Late	5	2.66	38341	5	1117	3
Oregon Coast	33	6.35	-58750	-42	-30416	-62
Oregon Aqua-culture	0	3.40	-7035	-20	0	0
California	20	95.12	-495	-36	0	0
Rogue	50	20.75	-609	-61	-335	-63
Chehalis Hatchery	0	10.74	481	2	0	0
Willapa	5	2.67	3652	2	54	0

Table 5: Summary of Stock Changes in Modeled Fisheries (Part II) , run=run05

Stock	Wild Escapement	% Delta Wild Escapement	Total Marked ER	Total Unmarked ER	Total Wild ER
Georgia Strait-Mainland	87757	0	0.79	0.75	0.75
Georgia Strait-Vancouver Island	10140	0	0.76	0.75	0.75
North Coast British Columbia	409077	0	0.75	0.75	0.75
NW Vancouver Island	77116	0	0.75	0.75	0.75
Queen Charlotte Island	130057	0	0.00	0.75	0.75
Trans Boundary	18184	0	0.00	0.75	0.75
South AK In	259080	0	0.00	0.75	0.75
South AK Out	80826	0	0.00	0.75	0.75
North AK In	92757	0	0.00	0.75	0.75
North AK Out	83453	0	0.00	0.75	0.75
Nooksack/Samish	12123	16	0.73	0.69	0.69
Bellingham Bay Heritage	0	0	0.00	0.68	0.00
Skagit Wild	21122	0	0.00	0.00	0.60
Skagit Hatchery	0	0	0.71	0.59	0.00
Swinomish Channel	0	0	0.68	0.00	0.00
Stillaguamish/Snohomish	81280	0	0.79	0.73	0.73
South Sound	40342	42	0.84	0.77	0.77
Nisqually Hatchery	0	0	0.00	0.77	0.00
Quilcene Hatchery	0	0	0.67	0.59	0.00
Port Gamble Hatchery	0	0	0.67	0.00	0.00
Quilcene Bay Net Pens	0	0	0.67	0.59	0.00
Hood Canal Wild	34745	0	0.00	0.00	0.58
George Adams Hatchery	0	0	0.67	0.59	0.00
JDF/Area 9/Dungeness/Elwha	4959	0	0.81	0.67	0.67
Elwha Hatchery	0	0	0.00	0.67	0.00
Port Angeles Net Pens	0	0	0.80	0.00	0.00
Makah	1616	0	0.00	0.51	0.51
Hoh	4593	0	0.00	0.00	0.62
Quilayute	29429	0	0.62	0.55	0.55
Queets	6242	0	0.81	0.75	0.75
Quinault	16301	0	0.75	0.70	0.70
Grays Harbor Wild	40499	0	0.76	0.72	0.72
Grays Harbor Hatchery	0	0	0.76	0.00	0.00
Columbia River-Early	9553	59	0.90	0.79	0.79
Columbia River-Late	9293	-11	0.90	0.83	0.83
Oregon Coast	72090	73	0.47	0.20	0.20
Oregon Aqua-culture	0	0	0.46	0.26	0.00
California	252	0	0.71	0.54	0.54
Rogue	788	74	0.48	0.20	0.20
Chehalis Hatchery	0	0	0.76	0.72	0.00
Willapa	3711	-1	0.80	0.75	0.75

Table 6: Exploitation Rates by Stock and Fishery - Run = run05

Stock	Fishery ¹	Fishery Specific ER				Cumulative ER			
		Mark	Unmark	Wild	Base	Mark	Unmark	Wild	Base
Georgia Strait-Mainland	ALL.AK.TROLL	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Georgia Strait-Mainland	NBC.TROLL	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003
Georgia Strait-Mainland	NCBC.TROLL	0.001	0.001	0.001	0.001	0.004	0.004	0.004	0.004
Georgia Strait-Mainland	SCBC.TROLL	0.005	0.005	0.005	0.005	0.009	0.009	0.009	0.009
Georgia Strait-Mainland	NWVI.TROLL	0.080	0.082	0.082	0.081	0.089	0.091	0.091	0.090
Georgia Strait-Mainland	SWVI.TROLL	0.316	0.321	0.321	0.319	0.406	0.412	0.412	0.408
Georgia Strait-Mainland	GS.TROLL	0.006	0.006	0.006	0.006	0.412	0.419	0.419	0.414
Georgia Strait-Mainland	CBC.NET	0.001	0.001	0.001	0.001	0.412	0.419	0.419	0.415
Georgia Strait-Mainland	JOHNSTONE.NET	0.027	0.029	0.029	0.028	0.440	0.448	0.448	0.443
Georgia Strait-Mainland	GEORGIA.STRAIT.NET	0.001	0.001	0.001	0.001	0.440	0.449	0.449	0.444
Georgia Strait-Mainland	JDF.NET	0.057	0.060	0.060	0.059	0.497	0.508	0.508	0.502
Georgia Strait-Mainland	JDF.SPORT	0.042	0.044	0.044	0.043	0.539	0.552	0.552	0.545
Georgia Strait-Mainland	WCVI.SPORT	0.006	0.006	0.006	0.006	0.544	0.557	0.557	0.550
Georgia Strait-Mainland	NK/SAMISH.MARINE.NET	0.006	0.007	0.007	0.007	0.550	0.564	0.564	0.556
Georgia Strait-Mainland	AR.10.NET	0.003	0.004	0.004	0.004	0.553	0.567	0.567	0.560
Georgia Strait-Mainland	AREA.4B-5-6C.NET	0.009	0.009	0.009	0.009	0.562	0.576	0.576	0.569
Georgia Strait-Mainland	AREA.5-6.TROLL	0.001	0.001	0.001	0.001	0.563	0.577	0.577	0.570
Georgia Strait-Mainland	AREA.6/6A/7/7A.NET	0.035	0.037	0.037	0.037	0.598	0.614	0.614	0.606
Georgia Strait-Mainland	AREA.5-6.SPORT	0.052	0.015	0.015	0.033	0.650	0.628	0.628	0.639
Georgia Strait-Mainland	AREA.7.SPORT	0.002	0.000	0.000	0.002	0.652	0.628	0.628	0.641
Georgia Strait-Mainland	QUILLAYUTE.RIVER.NET	0.002	0.002	0.002	0.002	0.654	0.630	0.630	0.642
Georgia Strait-Mainland	COLRIV.MOUTH.SPORT	0.001	0.000	0.000	0.001	0.655	0.630	0.630	0.644
Georgia Strait-Mainland	WA.AREA.2.SPORT	0.012	0.002	0.002	0.005	0.667	0.633	0.633	0.649
Georgia Strait-Mainland	WA.AREA.3.TROLL.&.SPORT	0.001	0.001	0.002	0.001	0.669	0.635	0.635	0.650
Georgia Strait-Mainland	WA.AREA.4/4B.TROLL	0.014	0.015	0.015	0.015	0.683	0.650	0.650	0.665
Georgia Strait-Mainland	WA.AREA.4.SPORT	0.018	0.004	0.004	0.006	0.701	0.654	0.654	0.671
Georgia Strait-Mainland	BUOY.10.SPORT	0.001	0.000	0.000	0.001	0.701	0.654	0.654	0.672
Georgia Strait-Mainland	TILLAMOOK.TROLL	0.002	0.001	0.001	0.003	0.704	0.655	0.655	0.676
Georgia Strait-Mainland	NEWPORT.TROLL	0.001	0.000	0.000	0.001	0.705	0.655	0.655	0.678
Georgia Strait-Mainland	NORTHERN.GEORGIA.STRAIT	0.016	0.017	0.017	0.017	0.721	0.671	0.671	0.694
Georgia Strait-Mainland	SOUTHERN.GEORGIA.STRAIT	0.005	0.005	0.005	0.005	0.727	0.677	0.677	0.700
Georgia Strait-Mainland	TERMINAL	0.063	0.073	0.073	0.050	0.790	0.750	0.750	0.750
Georgia Strait-Vancouver Island	ALL.AK.TROLL	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Georgia Strait-Vancouver Island	NBC.TROLL	0.008	0.008	0.008	0.008	0.010	0.010	0.010	0.010
Georgia Strait-Vancouver Island	NCBC.TROLL	0.003	0.003	0.003	0.003	0.013	0.013	0.013	0.013
Georgia Strait-Vancouver Island	SCBC.TROLL	0.025	0.025	0.025	0.025	0.037	0.037	0.037	0.037
Georgia Strait-Vancouver Island	NWVI.TROLL	0.172	0.175	0.175	0.174	0.209	0.211	0.211	0.211
Georgia Strait-Vancouver Island	SWVI.TROLL	0.165	0.166	0.166	0.165	0.374	0.378	0.378	0.377
Georgia Strait-Vancouver Island	GS.TROLL	0.007	0.007	0.007	0.007	0.381	0.385	0.385	0.384
Georgia Strait-Vancouver Island	NBC.NET	0.001	0.001	0.001	0.001	0.381	0.385	0.385	0.384
Georgia Strait-Vancouver Island	CBC.NET	0.003	0.003	0.003	0.003	0.384	0.388	0.388	0.387
Georgia Strait-Vancouver Island	JOHNSTONE.NET	0.103	0.105	0.105	0.104	0.487	0.493	0.493	0.491
Georgia Strait-Vancouver Island	GEORGIA.STRAIT.NET	0.039	0.039	0.039	0.039	0.525	0.532	0.532	0.530
Georgia Strait-Vancouver Island	JDF.NET	0.045	0.046	0.046	0.046	0.571	0.579	0.578	0.576
Georgia Strait-Vancouver Island	JDF.SPORT	0.023	0.024	0.024	0.024	0.594	0.603	0.603	0.600
Georgia Strait-Vancouver Island	WCVI.SPORT	0.010	0.010	0.011	0.010	0.605	0.613	0.613	0.610

¹Fisheries are summed over time periods.

Exploitation Rates by Stock and Fishery – continued from previous page

Stock	Fishery ¹	Fishery Specific ER				Cumulative ER			
		Mark	Unmark	Wild	Base	Mark	Unmark	Wild	Base
Queen Charlotte Island	NWVI.TROLL	0.000	0.023	0.023	0.023	0.000	0.506	0.506	0.506
Queen Charlotte Island	NBC.NET	0.000	0.165	0.165	0.165	0.000	0.671	0.671	0.671
Queen Charlotte Island	CBC.NET	0.000	0.001	0.001	0.001	0.000	0.672	0.672	0.672
Queen Charlotte Island	JOHNSTONE.NET	0.000	0.002	0.002	0.002	0.000	0.674	0.674	0.674
Queen Charlotte Island	ALL.AK.NET	0.000	0.026	0.026	0.026	0.000	0.700	0.700	0.700
Queen Charlotte Island	TERMINAL	0.000	0.050	0.050	0.050	0.000	0.750	0.750	0.750
Trans Boundary	ALL.AK.TROLL	0.000	0.550	0.550	0.550	0.000	0.550	0.550	0.550
Trans Boundary	NBC.TROLL	0.000	0.021	0.021	0.021	0.000	0.571	0.571	0.571
Trans Boundary	AK.NET	0.000	0.119	0.119	0.119	0.000	0.690	0.690	0.690
Trans Boundary	ALL.AK.NET	0.000	0.010	0.010	0.010	0.000	0.700	0.700	0.700
Trans Boundary	TERMINAL	0.000	0.050	0.050	0.050	0.000	0.750	0.750	0.750
South AK In	ALL.AK.TROLL	0.000	0.254	0.254	0.254	0.000	0.254	0.254	0.254
South AK In	NBC.TROLL	0.000	0.069	0.069	0.069	0.000	0.323	0.323	0.323
South AK In	NCBC.TROLL	0.000	0.001	0.001	0.001	0.000	0.324	0.324	0.324
South AK In	SCBC.TROLL	0.000	0.001	0.001	0.001	0.000	0.325	0.325	0.325
South AK In	NWVI.TROLL	0.000	0.006	0.006	0.006	0.000	0.331	0.331	0.331
South AK In	SWVI.TROLL	0.000	0.001	0.001	0.001	0.000	0.332	0.332	0.332
South AK In	NBC.NET	0.000	0.004	0.004	0.004	0.000	0.336	0.336	0.336
South AK In	CBC.NET	0.000	0.001	0.001	0.001	0.000	0.336	0.336	0.336
South AK In	ALL.AK.NET	0.000	0.363	0.363	0.363	0.000	0.700	0.700	0.700
South AK In	TERMINAL	0.000	0.050	0.050	0.050	0.000	0.750	0.750	0.750
South AK Out	ALL.AK.TROLL	0.000	0.414	0.414	0.414	0.000	0.414	0.414	0.414
South AK Out	NBC.TROLL	0.000	0.051	0.051	0.051	0.000	0.466	0.466	0.466
South AK Out	NCBC.TROLL	0.000	0.002	0.002	0.002	0.000	0.468	0.468	0.468
South AK Out	SCBC.TROLL	0.000	0.001	0.001	0.001	0.000	0.468	0.468	0.468
South AK Out	NWVI.TROLL	0.000	0.001	0.001	0.001	0.000	0.469	0.469	0.469
South AK Out	NBC.NET	0.000	0.004	0.004	0.004	0.000	0.473	0.473	0.473
South AK Out	CBC.NET	0.000	0.001	0.001	0.001	0.000	0.473	0.473	0.473
South AK Out	ALL.AK.NET	0.000	0.227	0.227	0.227	0.000	0.700	0.700	0.700
South AK Out	TERMINAL	0.000	0.050	0.050	0.050	0.000	0.750	0.750	0.750
North AK In	ALL.AK.TROLL	0.000	0.474	0.474	0.474	0.000	0.474	0.474	0.474
North AK In	NBC.TROLL	0.000	0.005	0.005	0.005	0.000	0.478	0.478	0.478
North AK In	AK.NET	0.000	0.216	0.216	0.216	0.000	0.694	0.694	0.694
North AK In	ALL.AK.NET	0.000	0.006	0.006	0.006	0.000	0.700	0.700	0.700
North AK In	TERMINAL	0.000	0.050	0.050	0.050	0.000	0.750	0.750	0.750
North AK Out	ALL.AK.TROLL	0.000	0.683	0.683	0.683	0.000	0.683	0.683	0.683
North AK Out	NBC.TROLL	0.000	0.004	0.004	0.004	0.000	0.686	0.686	0.686
North AK Out	NBC.NET	0.000	0.001	0.001	0.001	0.000	0.688	0.688	0.688
North AK Out	ALL.AK.NET	0.000	0.012	0.012	0.012	0.000	0.700	0.700	0.700
North AK Out	TERMINAL	0.000	0.050	0.050	0.050	0.000	0.750	0.750	0.750

Exploitation Rates by Stock and Fishery – continued from previous page

Stock	Fishery ¹	Fishery Specific ER				Cumulative ER			
		Mark	Unmark	Wild	Base	Mark	Unmark	Wild	Base
Skagit Wild	NWVI.TROLL	0.000	0.000	0.043	0.042	0.000	0.000	0.046	0.045
Skagit Wild	SWVI.TROLL	0.000	0.000	0.209	0.205	0.000	0.000	0.255	0.249
Skagit Wild	JDF.NET	0.000	0.000	0.045	0.044	0.000	0.000	0.300	0.293
Skagit Wild	JDF.SPORT	0.000	0.000	0.025	0.023	0.000	0.000	0.325	0.317
Skagit Wild	WCVI.SPORT	0.000	0.000	0.005	0.005	0.000	0.000	0.331	0.322
Skagit Wild	SKAGIT.MAR.&FW.NET	0.000	0.000	0.072	0.069	0.000	0.000	0.403	0.390
Skagit Wild	STL/SNO.MARINE.NET	0.000	0.000	0.034	0.032	0.000	0.000	0.437	0.422
Skagit Wild	AR.10.NET	0.000	0.000	0.015	0.013	0.000	0.000	0.451	0.435
Skagit Wild	AREA.4B-5-6C.NET	0.000	0.000	0.017	0.016	0.000	0.000	0.469	0.451
Skagit Wild	AREA.6/6A/7/A.NET	0.000	0.000	0.003	0.003	0.000	0.000	0.472	0.454
Skagit Wild	AREA.5-6.SPORT	0.000	0.000	0.030	0.068	0.000	0.000	0.501	0.522
Skagit Wild	AREA.8.SPORT	0.000	0.000	0.002	0.007	0.000	0.000	0.503	0.528
Skagit Wild	AREA.9.SPORT	0.000	0.000	0.010	0.023	0.000	0.000	0.512	0.551
Skagit Wild	AREA.10/11.SPORT	0.000	0.000	0.001	0.007	0.000	0.000	0.514	0.558
Skagit Wild	WA.AREA.2.SPORT	0.000	0.000	0.004	0.006	0.000	0.000	0.517	0.564
Skagit Wild	WA.AREA.3.TROLL.&SPORT	0.000	0.000	0.001	0.001	0.000	0.000	0.518	0.565
Skagit Wild	WA.AREA.4/4B.TROLL	0.000	0.000	0.020	0.020	0.000	0.000	0.539	0.585
Skagit Wild	WA.AREA.4.SPORT	0.000	0.000	0.006	0.010	0.000	0.000	0.545	0.595
Skagit Wild	BUOY.10.SPORT	0.000	0.000	0.001	0.002	0.000	0.000	0.546	0.597
Skagit Wild	COOS.BAY.&EST.SPORT	0.000	0.000	0.000	0.002	0.000	0.000	0.546	0.598
Skagit Wild	NEWPORT.TROLL	0.000	0.000	0.000	0.002	0.000	0.000	0.546	0.600
Skagit Wild	COOS.BAY.TROLL	0.000	0.000	0.000	0.001	0.000	0.000	0.546	0.601
Skagit Wild	TERMINAL	0.000	0.000	0.054	0.000	0.000	0.000	0.600	0.601
Skagit Hatchery	NWVI.TROLL	0.038	0.040	0.000	0.039	0.039	0.040	0.000	0.039
Skagit Hatchery	SWVI.TROLL	0.190	0.194	0.000	0.192	0.230	0.235	0.000	0.231
Skagit Hatchery	JDF.NET	0.043	0.045	0.000	0.044	0.272	0.280	0.000	0.275
Skagit Hatchery	JDF.SPORT	0.012	0.014	0.000	0.013	0.284	0.294	0.000	0.288
Skagit Hatchery	WCVI.SPORT	0.007	0.007	0.000	0.007	0.291	0.300	0.000	0.295
Skagit Hatchery	SKAGIT.MAR.&FW.NET	0.044	0.054	0.000	0.050	0.334	0.354	0.000	0.345
Skagit Hatchery	STL/SNO.MARINE.NET	0.044	0.052	0.000	0.048	0.378	0.407	0.000	0.393
Skagit Hatchery	AR.10.NET	0.016	0.021	0.000	0.019	0.394	0.428	0.000	0.412
Skagit Hatchery	AREA.4B-5-6C.NET	0.021	0.023	0.000	0.022	0.414	0.450	0.000	0.433
Skagit Hatchery	AREA.6/6A/7/A.NET	0.005	0.007	0.000	0.006	0.419	0.457	0.000	0.439
Skagit Hatchery	AREA.5-6.SPORT	0.113	0.031	0.000	0.070	0.533	0.488	0.000	0.509
Skagit Hatchery	AREA.8.SPORT	0.007	0.001	0.000	0.007	0.539	0.489	0.000	0.516
Skagit Hatchery	AREA.9.SPORT	0.045	0.011	0.000	0.025	0.585	0.500	0.000	0.541
Skagit Hatchery	AREA.10/11.SPORT	0.012	0.003	0.000	0.013	0.596	0.503	0.000	0.554
Skagit Hatchery	WA.AREA.2.SPORT	0.016	0.004	0.000	0.006	0.612	0.507	0.000	0.561
Skagit Hatchery	WA.AREA.4/4B.TROLL	0.019	0.019	0.000	0.019	0.631	0.527	0.000	0.580
Skagit Hatchery	WA.AREA.4.SPORT	0.034	0.008	0.000	0.013	0.664	0.535	0.000	0.593
Skagit Hatchery	BUOY.10.SPORT	0.005	0.001	0.000	0.005	0.669	0.536	0.000	0.598
Skagit Hatchery	COOS.BAY.&EST.SPORT	0.001	0.000	0.000	0.002	0.670	0.536	0.000	0.600
Skagit Hatchery	TERMINAL	0.040	0.054	0.000	0.000	0.710	0.590	0.000	0.600

Exploitation Rates by Stock and Fishery - continued from previous page

Stock	Fishery ¹	Fishery Specific ER				Cumulative ER			
		Mark	Unmark	Wild	Base	Mark	Unmark	Wild	Base
Stillaguamish/Snohomish	AREA.9.SPORT	0.011	0.003	0.003	0.007	0.683	0.633	0.633	0.659
Stillaguamish/Snohomish	AREA.10/11.SPORT	0.002	0.000	0.000	0.002	0.684	0.633	0.633	0.661
Stillaguamish/Snohomish	COLRIV.MOUTH.SPORT	0.001	0.000	0.000	0.001	0.685	0.634	0.634	0.661
Stillaguamish/Snohomish	WA.AREA.2.SPORT	0.022	0.007	0.007	0.010	0.708	0.639	0.639	0.671
Stillaguamish/Snohomish	WA.AREA.3.TROLL.&.SPORT	0.001	0.001	0.001	0.001	0.709	0.641	0.641	0.672
Stillaguamish/Snohomish	WA.AREA.4/4B.TROLL	0.015	0.016	0.016	0.016	0.724	0.657	0.657	0.688
Stillaguamish/Snohomish	WA.AREA.4.SPORT	0.006	0.002	0.002	0.003	0.731	0.658	0.658	0.691
Stillaguamish/Snohomish	TILLAMOOK.&.EST.SPORT	0.001	0.000	0.000	0.001	0.732	0.658	0.658	0.691
Stillaguamish/Snohomish	NWPRT.&.EST.SPORT	0.001	0.000	0.000	0.001	0.733	0.659	0.659	0.693
Stillaguamish/Snohomish	TILLAMOOK.TROLL	0.003	0.001	0.001	0.005	0.736	0.660	0.660	0.698
Stillaguamish/Snohomish	NEWPORT.TROLL	0.001	0.000	0.000	0.002	0.737	0.660	0.660	0.699
Stillaguamish/Snohomish	NORTHERN.GEORGIA STRAIT	0.001	0.001	0.001	0.001	0.738	0.661	0.661	0.700
Stillaguamish/Snohomish	TERMINAL	0.052	0.069	0.069	0.030	0.790	0.730	0.730	0.731
South Sound	NBC.TROLL	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
South Sound	SCBC.TROLL	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002
South Sound	NWVI.TROLL	0.052	0.053	0.053	0.053	0.054	0.055	0.056	0.055
South Sound	SWVI.TROLL	0.239	0.244	0.245	0.241	0.292	0.300	0.300	0.296
South Sound	JDF.NET	0.048	0.051	0.051	0.050	0.340	0.351	0.351	0.346
South Sound	JDF.SPORT	0.014	0.014	0.014	0.014	0.354	0.366	0.366	0.361
South Sound	WCVI.SPORT	0.003	0.003	0.003	0.003	0.356	0.369	0.369	0.363
South Sound	NK/SAMISH.MARINE.NET	0.002	0.002	0.002	0.002	0.358	0.371	0.371	0.365
South Sound	STL/SNO.MARINE.NET	0.017	0.018	0.018	0.017	0.375	0.388	0.389	0.382
South Sound	AR.10.NET	0.176	0.188	0.188	0.182	0.550	0.577	0.577	0.564
South Sound	AREA.4B-5-6C.NET	0.011	0.012	0.012	0.012	0.562	0.589	0.589	0.576
South Sound	AREA.5-6.TROLL	0.001	0.001	0.001	0.001	0.563	0.590	0.591	0.578
South Sound	AREA.6/6A/7/7A.NET	0.003	0.003	0.003	0.003	0.566	0.593	0.594	0.581
South Sound	AREA.5-6.SPORT	0.076	0.021	0.021	0.047	0.642	0.613	0.613	0.628
South Sound	AREA.8.SPORT	0.007	0.001	0.001	0.004	0.649	0.615	0.615	0.632
South Sound	AREA.9.SPORT	0.027	0.006	0.006	0.016	0.676	0.621	0.621	0.648
South Sound	AREA.10/11.SPORT	0.027	0.006	0.006	0.029	0.703	0.627	0.627	0.676
South Sound	COLRIV.MOUTH.TROLL	0.001	0.001	0.001	0.001	0.704	0.628	0.628	0.677
South Sound	WA.AREA.2.SPORT	0.015	0.004	0.004	0.006	0.720	0.632	0.632	0.684
South Sound	WA.AREA.3.TROLL.&.SPORT	0.009	0.009	0.009	0.009	0.728	0.641	0.641	0.693
South Sound	WA.AREA.4/4B.TROLL	0.013	0.014	0.014	0.014	0.742	0.655	0.655	0.707
South Sound	WA.AREA.4.SPORT	0.016	0.004	0.004	0.006	0.758	0.659	0.659	0.713
South Sound	TILLAMOOK.&.EST.SPORT	0.000	0.000	0.000	0.001	0.758	0.659	0.659	0.714
South Sound	TILLAMOOK.TROLL	0.002	0.001	0.001	0.003	0.761	0.660	0.660	0.718
South Sound	NEWPORT.TROLL	0.001	0.000	0.000	0.001	0.762	0.660	0.661	0.719
South Sound	SOUTHERN.GEORGIA STRAIT	0.001	0.001	0.001	0.001	0.763	0.661	0.661	0.720
South Sound	TERMINAL	0.077	0.109	0.109	0.120	0.840	0.770	0.770	0.840
Nisqually Hatchery	NWVI.TROLL	0.000	0.019	0.000	0.019	0.000	0.019	0.000	0.019
Nisqually Hatchery	SWVI.TROLL	0.000	0.250	0.000	0.247	0.000	0.270	0.000	0.265
Nisqually Hatchery	JDF.NET	0.000	0.059	0.000	0.058	0.000	0.328	0.000	0.323

Exploitation Rates by Stock and Fishery – continued from previous page

Stock	Fishery ¹	Fishery Specific ER				Cumulative ER			
		Mark	Unmark	Wild	Base	Mark	Unmark	Wild	Base
Port Gamble Hatchery	JDF.NET	0.042	0.000	0.000	0.043	0.323	0.000	0.000	0.328
Port Gamble Hatchery	JDF.SPORT	0.015	0.000	0.000	0.016	0.338	0.000	0.000	0.344
Port Gamble Hatchery	AR.10.NET	0.055	0.000	0.000	0.057	0.394	0.000	0.000	0.401
Port Gamble Hatchery	AREA.4B-5-6C.NET	0.015	0.000	0.000	0.016	0.409	0.000	0.000	0.417
Port Gamble Hatchery	AREA.5-6.TROLL	0.002	0.000	0.000	0.002	0.411	0.000	0.000	0.419
Port Gamble Hatchery	AREA.5-6.SPORT	0.123	0.000	0.000	0.076	0.533	0.000	0.000	0.495
Port Gamble Hatchery	AREA.9.SPORT	0.006	0.000	0.000	0.005	0.540	0.000	0.000	0.500
Port Gamble Hatchery	AREA.10/11.SPORT	0.002	0.000	0.000	0.002	0.542	0.000	0.000	0.503
Port Gamble Hatchery	COLRIV.MOUTH.SPORT	0.002	0.000	0.000	0.002	0.544	0.000	0.000	0.504
Port Gamble Hatchery	AREA.2.TROLL	0.001	0.000	0.000	0.002	0.545	0.000	0.000	0.506
Port Gamble Hatchery	WA.AREA.2.SPORT	0.006	0.000	0.000	0.002	0.551	0.000	0.000	0.509
Port Gamble Hatchery	WA.AREA.3.TROLL.&SPORT	0.013	0.000	0.000	0.013	0.565	0.000	0.000	0.522
Port Gamble Hatchery	WA.AREA.4/4B.TROLL	0.018	0.000	0.000	0.018	0.582	0.000	0.000	0.540
Port Gamble Hatchery	WA.AREA.4.SPORT	0.012	0.000	0.000	0.005	0.594	0.000	0.000	0.545
Port Gamble Hatchery	COOS.BAY.&.EST.SPORT	0.000	0.000	0.000	0.001	0.595	0.000	0.000	0.545
Port Gamble Hatchery	TILLAMOOK.TROLL	0.003	0.000	0.000	0.004	0.598	0.000	0.000	0.550
Port Gamble Hatchery	TERMINAL	0.072	0.000	0.000	0.030	0.670	0.000	0.000	0.580
Quilcene Bay Net Pens	NCBC.TROLL	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.001
Quilcene Bay Net Pens	SCBC.TROLL	0.003	0.003	0.000	0.003	0.004	0.004	0.000	0.004
Quilcene Bay Net Pens	NWVI.TROLL	0.049	0.051	0.000	0.051	0.053	0.056	0.000	0.054
Quilcene Bay Net Pens	SWVI.TROLL	0.227	0.233	0.000	0.229	0.280	0.289	0.000	0.284
Quilcene Bay Net Pens	JDF.NET	0.042	0.044	0.000	0.043	0.322	0.334	0.000	0.328
Quilcene Bay Net Pens	JDF.SPORT	0.015	0.017	0.000	0.016	0.338	0.351	0.000	0.344
Quilcene Bay Net Pens	AR.10.NET	0.055	0.058	0.000	0.057	0.394	0.410	0.000	0.401
Quilcene Bay Net Pens	AREA.4B-5-6C.NET	0.015	0.016	0.000	0.016	0.409	0.426	0.000	0.417
Quilcene Bay Net Pens	AREA.5-6.TROLL	0.002	0.002	0.000	0.002	0.411	0.428	0.000	0.419
Quilcene Bay Net Pens	AREA.5-6.SPORT	0.123	0.032	0.000	0.076	0.533	0.460	0.000	0.495
Quilcene Bay Net Pens	AREA.9.SPORT	0.006	0.002	0.000	0.005	0.539	0.462	0.000	0.500
Quilcene Bay Net Pens	AREA.10/11.SPORT	0.002	0.001	0.000	0.002	0.541	0.462	0.000	0.502
Quilcene Bay Net Pens	COLRIV.MOUTH.SPORT	0.002	0.000	0.000	0.002	0.543	0.463	0.000	0.504
Quilcene Bay Net Pens	AREA.2.TROLL	0.002	0.002	0.000	0.002	0.545	0.464	0.000	0.506
Quilcene Bay Net Pens	WA.AREA.2.SPORT	0.006	0.002	0.000	0.002	0.551	0.466	0.000	0.508
Quilcene Bay Net Pens	WA.AREA.3.TROLL.&SPORT	0.013	0.013	0.000	0.013	0.564	0.479	0.000	0.522
Quilcene Bay Net Pens	WA.AREA.4/4B.TROLL	0.018	0.019	0.000	0.018	0.582	0.498	0.000	0.540
Quilcene Bay Net Pens	WA.AREA.4.SPORT	0.012	0.003	0.000	0.005	0.594	0.501	0.000	0.544
Quilcene Bay Net Pens	COOS.BAY.&.EST.SPORT	0.000	0.000	0.000	0.001	0.594	0.501	0.000	0.545
Quilcene Bay Net Pens	TILLAMOOK.TROLL	0.003	0.001	0.000	0.004	0.597	0.502	0.000	0.549
Quilcene Bay Net Pens	TERMINAL	0.072	0.088	0.000	0.030	0.669	0.590	0.000	0.580
Hood Canal Wild	SCBC.TROLL	0.000	0.000	0.008	0.008	0.000	0.000	0.008	0.008
Hood Canal Wild	NWVI.TROLL	0.000	0.000	0.043	0.041	0.000	0.000	0.051	0.050
Hood Canal Wild	SWVI.TROLL	0.000	0.000	0.195	0.192	0.000	0.000	0.246	0.242
Hood Canal Wild	JDF.NET	0.000	0.000	0.057	0.055	0.000	0.000	0.303	0.296
Hood Canal Wild	JDF.SPORT	0.000	0.000	0.015	0.013	0.000	0.000	0.318	0.310

Exploitation Rates by Stock and Fishery – continued from previous page

Stock	Fishery ¹	Fishery Specific ER				Cumulative ER			
		Mark	Unmark	Wild	Base	Mark	Unmark	Wild	Base
JDF/Area 9/Dungeness/Elwha	AREA.5-6.SPORT	0.267	0.078	0.075	0.162	0.718	0.548	0.545	0.618
JDF/Area 9/Dungeness/Elwha	NEWPORT.TROLL	0.028	0.009	0.011	0.042	0.746	0.557	0.556	0.660
JDF/Area 9/Dungeness/Elwha	TERMINAL	0.064	0.113	0.114	0.010	0.810	0.670	0.670	0.670
Elwha Hatchery	NWVI.TROLL	0.000	0.134	0.000	0.129	0.000	0.133	0.000	0.129
Elwha Hatchery	SWVI.TROLL	0.000	0.255	0.000	0.255	0.000	0.388	0.000	0.383
Elwha Hatchery	JOHNSTONE.NET	0.000	0.071	0.000	0.063	0.000	0.459	0.000	0.446
Elwha Hatchery	AREA.4B-5-6C.NET	0.000	0.011	0.000	0.009	0.000	0.470	0.000	0.456
Elwha Hatchery	AREA.5-6.SPORT	0.000	0.075	0.000	0.163	0.000	0.545	0.000	0.619
Elwha Hatchery	NEWPORT.TROLL	0.000	0.011	0.000	0.042	0.000	0.556	0.000	0.660
Elwha Hatchery	TERMINAL	0.000	0.114	0.000	0.009	0.000	0.670	0.000	0.670
Port Angeles Net Pens	NWVI.TROLL	0.049	0.000	0.000	0.051	0.048	0.000	0.000	0.051
Port Angeles Net Pens	SWVI.TROLL	0.283	0.000	0.000	0.286	0.330	0.000	0.000	0.336
Port Angeles Net Pens	JDF.NET	0.064	0.000	0.000	0.068	0.394	0.000	0.000	0.404
Port Angeles Net Pens	JDF.SPORT	0.023	0.000	0.000	0.023	0.417	0.000	0.000	0.428
Port Angeles Net Pens	AREA.4B-5-6C.NET	0.030	0.000	0.000	0.033	0.448	0.000	0.000	0.460
Port Angeles Net Pens	AREA.5-6.TROLL	0.005	0.000	0.000	0.005	0.453	0.000	0.000	0.466
Port Angeles Net Pens	AREA.6/6A/7/7A.NET	0.003	0.000	0.000	0.002	0.455	0.000	0.000	0.468
Port Angeles Net Pens	AREA.5-6.SPORT	0.184	0.000	0.000	0.122	0.639	0.000	0.000	0.589
Port Angeles Net Pens	COLRIV.MOUTH.SPORT	0.002	0.000	0.000	0.002	0.640	0.000	0.000	0.591
Port Angeles Net Pens	WA.AREA.2.SPORT	0.022	0.000	0.000	0.009	0.662	0.000	0.000	0.600
Port Angeles Net Pens	WA.AREA.3.TROLL.&SPORT	0.003	0.000	0.000	0.003	0.665	0.000	0.000	0.603
Port Angeles Net Pens	WA.AREA.4/4B.TROLL	0.019	0.000	0.000	0.019	0.684	0.000	0.000	0.622
Port Angeles Net Pens	WA.AREA.4.SPORT	0.032	0.000	0.000	0.012	0.715	0.000	0.000	0.634
Port Angeles Net Pens	COOS.BAY.&.EST.SPORT	0.004	0.000	0.000	0.005	0.718	0.000	0.000	0.639
Port Angeles Net Pens	TILLAMOOK.TROLL	0.007	0.000	0.000	0.010	0.725	0.000	0.000	0.649
Port Angeles Net Pens	NEWPORT.TROLL	0.004	0.000	0.000	0.006	0.729	0.000	0.000	0.656
Port Angeles Net Pens	COOS.BAY.TROLL	0.003	0.000	0.000	0.004	0.731	0.000	0.000	0.660
Port Angeles Net Pens	TERMINAL	0.069	0.000	0.000	0.010	0.800	0.000	0.000	0.670
Makah	ALL.AK.TROLL	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001
Makah	NBC.TROLL	0.000	0.004	0.004	0.004	0.000	0.005	0.005	0.005
Makah	SCBC.TROLL	0.000	0.004	0.005	0.004	0.000	0.009	0.009	0.009
Makah	NWVI.TROLL	0.000	0.120	0.120	0.112	0.000	0.129	0.130	0.121
Makah	SWVI.TROLL	0.000	0.186	0.188	0.175	0.000	0.315	0.317	0.295
Makah	JOHNSTONE.NET	0.000	0.001	0.001	0.001	0.000	0.317	0.318	0.296
Makah	JDF.NET	0.000	0.013	0.013	0.012	0.000	0.330	0.331	0.308
Makah	JDF.SPORT	0.000	0.003	0.003	0.003	0.000	0.333	0.334	0.311
Makah	WCVI.SPORT	0.000	0.003	0.003	0.003	0.000	0.337	0.337	0.315
Makah	AREA.4B-5-6C.NET	0.000	0.007	0.008	0.007	0.000	0.344	0.345	0.322
Makah	AREA.6/6A/7/7A.NET	0.000	0.001	0.001	0.001	0.000	0.345	0.346	0.323
Makah	AREA.5-6.SPORT	0.000	0.013	0.014	0.029	0.000	0.358	0.359	0.352
Makah	QUILLAYUTE.RIVER.NET	0.000	0.001	0.001	0.001	0.000	0.359	0.360	0.353
Makah	COLRIV.MOUTH.TROLL	0.000	0.002	0.002	0.002	0.000	0.361	0.361	0.355

Exploitation Rates by Stock and Fishery – *continued from previous page*

Stock	Fishery ¹	Fishery Specific ER				Cumulative ER			
		Mark	Unmark	Wild	Base	Mark	Unmark	Wild	Base
Quilayute	AREA.4B-5-6C.NET	0.009	0.009	0.009	0.009	0.337	0.378	0.378	0.348
Quilayute	AREA.6/6A/7/7A.NET	0.001	0.001	0.001	0.001	0.338	0.379	0.379	0.349
Quilayute	AREA.5-6.SPORT	0.051	0.013	0.013	0.030	0.388	0.392	0.392	0.380
Quilayute	QUILLAYUTE.RIVER.NET	0.013	0.015	0.015	0.014	0.401	0.407	0.407	0.394
Quilayute	COLRIV.MOUTH.TROLL	0.008	0.008	0.008	0.008	0.409	0.416	0.416	0.402
Quilayute	COLRIV.MOUTH.SPORT	0.010	0.003	0.003	0.010	0.419	0.418	0.418	0.413
Quilayute	AREA.2.TROLL	0.005	0.005	0.005	0.005	0.424	0.424	0.424	0.418
Quilayute	WA.AREA.2.SPORT	0.050	0.013	0.013	0.021	0.474	0.437	0.437	0.438
Quilayute	WA.AREA.3.TROLL.&.SPORT	0.014	0.015	0.015	0.014	0.488	0.451	0.451	0.452
Quilayute	WA.AREA.4/4B.TROLL	0.026	0.028	0.028	0.027	0.513	0.479	0.479	0.478
Quilayute	WA.AREA.4.SPORT	0.020	0.005	0.005	0.007	0.534	0.484	0.484	0.485
Quilayute	BUOY.10.SPORT	0.002	0.000	0.000	0.002	0.535	0.484	0.484	0.486
Quilayute	TILLAMOOK.&.EST.SPORT	0.004	0.001	0.001	0.007	0.539	0.485	0.485	0.493
Quilayute	NWPRT.&.EST.SPORT	0.003	0.001	0.001	0.004	0.542	0.486	0.486	0.497
Quilayute	COOS.BAY.&.EST.SPORT	0.002	0.000	0.000	0.002	0.543	0.486	0.486	0.499
Quilayute	TILLAMOOK.TROLL	0.021	0.008	0.008	0.031	0.564	0.494	0.495	0.530
Quilayute	NEWPORT.TROLL	0.009	0.004	0.004	0.014	0.573	0.498	0.498	0.544
Quilayute	COOS.BAY.TROLL	0.004	0.001	0.001	0.005	0.576	0.499	0.500	0.549
Quilayute	CALIF.FTB/SOCAL.ALL	0.001	0.000	0.000	0.001	0.578	0.500	0.500	0.550
Quilayute	TERMINAL	0.042	0.050	0.050	0.000	0.620	0.550	0.550	0.550
Queets	NBC.TROLL	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Queets	SCBC.TROLL	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003
Queets	NWVI.TROLL	0.108	0.118	0.118	0.110	0.112	0.122	0.122	0.114
Queets	SWVI.TROLL	0.147	0.163	0.163	0.150	0.258	0.284	0.284	0.263
Queets	JDF.NET	0.017	0.019	0.019	0.017	0.275	0.303	0.303	0.280
Queets	JDF.SPORT	0.005	0.006	0.006	0.005	0.280	0.309	0.309	0.286
Queets	WCVI.SPORT	0.004	0.005	0.005	0.004	0.284	0.314	0.314	0.290
Queets	AR.10.NET	0.001	0.001	0.001	0.001	0.285	0.315	0.315	0.291
Queets	AREA.4B-5-6C.NET	0.004	0.004	0.004	0.004	0.288	0.318	0.318	0.294
Queets	AREA.6/6A/7/7A.NET	0.002	0.002	0.002	0.002	0.289	0.320	0.320	0.295
Queets	AREA.5-6.SPORT	0.028	0.008	0.008	0.017	0.317	0.328	0.328	0.312
Queets	GRAYS.HARBOR.ESTUARY.NET	0.002	0.002	0.002	0.002	0.319	0.330	0.330	0.314
Queets	COLRIV.MOUTH.TROLL	0.009	0.010	0.010	0.009	0.328	0.340	0.339	0.323
Queets	COLRIV.MOUTH.SPORT	0.012	0.003	0.003	0.012	0.340	0.342	0.342	0.336
Queets	AREA.2.TROLL	0.003	0.003	0.003	0.003	0.342	0.345	0.345	0.338
Queets	WA.AREA.2.SPORT	0.060	0.017	0.017	0.025	0.403	0.361	0.361	0.363
Queets	WA.AREA.3.TROLL.&.SPORT	0.018	0.019	0.019	0.018	0.420	0.380	0.380	0.380
Queets	WA.AREA.4/4B.TROLL	0.026	0.031	0.031	0.026	0.447	0.410	0.410	0.408
Queets	WA.AREA.4.SPORT	0.025	0.006	0.006	0.009	0.471	0.415	0.415	0.417
Queets	BUOY.10.SPORT	0.006	0.001	0.001	0.006	0.478	0.417	0.417	0.423
Queets	TILLAMOOK.&.EST.SPORT	0.003	0.001	0.001	0.005	0.481	0.418	0.418	0.428
Queets	NWPRT.&.EST.SPORT	0.009	0.003	0.003	0.014	0.490	0.420	0.420	0.442
Queets	COOS.BAY.&.EST.SPORT	0.006	0.001	0.001	0.008	0.495	0.421	0.421	0.450
Queets	TILLAMOOK.TROLL	0.027	0.011	0.011	0.041	0.522	0.432	0.432	0.491

Exploitation Rates by Stock and Fishery – continued from previous page

Stock	Fishery ¹	Fishery Specific ER				Cumulative ER			
		Mark	Unmark	Wild	Base	Mark	Unmark	Wild	Base
Grays Harbor Wild	NWVI.TROLL	0.077	0.080	0.080	0.077	0.090	0.092	0.092	0.090
Grays Harbor Wild	SWVI.TROLL	0.083	0.087	0.087	0.084	0.173	0.180	0.180	0.174
Grays Harbor Wild	JOHNSTONE.NET	0.001	0.001	0.001	0.001	0.175	0.181	0.181	0.175
Grays Harbor Wild	JDF.NET	0.006	0.006	0.006	0.006	0.181	0.188	0.188	0.182
Grays Harbor Wild	JDF.SPORT	0.007	0.007	0.007	0.007	0.188	0.195	0.195	0.189
Grays Harbor Wild	WCVI.SPORT	0.002	0.002	0.002	0.002	0.190	0.197	0.197	0.190
Grays Harbor Wild	AR.10.NET	0.001	0.001	0.001	0.001	0.190	0.198	0.197	0.191
Grays Harbor Wild	AREA.4B-5-6C.NET	0.008	0.008	0.008	0.008	0.198	0.206	0.205	0.199
Grays Harbor Wild	AREA.5-6.TROLL	0.001	0.001	0.001	0.001	0.199	0.206	0.206	0.200
Grays Harbor Wild	AREA.6/6A/7/7A.NET	0.003	0.003	0.003	0.003	0.202	0.209	0.209	0.203
Grays Harbor Wild	AREA.5-6.SPORT	0.017	0.005	0.005	0.012	0.218	0.213	0.213	0.214
Grays Harbor Wild	GRAYS.HARBOR.ESTUARY.NET	0.145	0.147	0.147	0.146	0.364	0.360	0.360	0.360
Grays Harbor Wild	COLRIV.MOUTH.TROLL	0.010	0.010	0.010	0.010	0.373	0.370	0.370	0.369
Grays Harbor Wild	COLRIV.MOUTH.SPORT	0.005	0.002	0.001	0.005	0.378	0.371	0.371	0.374
Grays Harbor Wild	AREA.2.TROLL	0.003	0.003	0.003	0.003	0.380	0.374	0.373	0.377
Grays Harbor Wild	WA.AREA.2.SPORT	0.021	0.005	0.005	0.007	0.400	0.379	0.379	0.385
Grays Harbor Wild	WA.AREA.3.TROLL.&SPORT	0.003	0.003	0.003	0.003	0.403	0.382	0.382	0.388
Grays Harbor Wild	WA.AREA.4/4B.TROLL	0.014	0.015	0.015	0.014	0.418	0.397	0.397	0.402
Grays Harbor Wild	WA.AREA.4.SPORT	0.006	0.001	0.002	0.002	0.424	0.399	0.398	0.405
Grays Harbor Wild	COLRIVER.LATE.NET	0.001	0.001	0.001	0.001	0.425	0.400	0.399	0.406
Grays Harbor Wild	BUOY.10.SPORT	0.007	0.001	0.001	0.007	0.431	0.401	0.401	0.413
Grays Harbor Wild	WA.GH.FW.NET	0.280	0.283	0.283	0.281	0.711	0.684	0.684	0.693
Grays Harbor Wild	TILLAMOOK.&.EST.SPORT	0.002	0.000	0.000	0.004	0.713	0.685	0.684	0.696
Grays Harbor Wild	NWPRT.&.EST.SPORT	0.001	0.000	0.000	0.002	0.715	0.685	0.684	0.698
Grays Harbor Wild	COOS.BAY.&.EST.SPORT	0.002	0.000	0.000	0.002	0.716	0.685	0.685	0.700
Grays Harbor Wild	TILLAMOOK.TROLL	0.005	0.002	0.002	0.007	0.721	0.687	0.687	0.708
Grays Harbor Wild	NEWPORT.TROLL	0.001	0.000	0.000	0.001	0.722	0.688	0.687	0.709
Grays Harbor Wild	COOS.BAY.TROLL	0.000	0.000	0.000	0.001	0.722	0.688	0.687	0.710
Grays Harbor Wild	QUINAULT.RIVER.NET	0.002	0.002	0.002	0.002	0.724	0.690	0.690	0.712
Grays Harbor Wild	GRAYS.HARBOR.ESTUARY.SPORT	0.012	0.003	0.003	0.008	0.736	0.693	0.693	0.720
Grays Harbor Wild	TERMINAL	0.024	0.028	0.028	0.000	0.760	0.721	0.720	0.720
Grays Harbor Hatchery	ALL.AK.TROLL	0.001	0.000	0.000	0.001	0.001	0.000	0.000	0.001
Grays Harbor Hatchery	NBC.TROLL	0.004	0.000	0.000	0.004	0.005	0.000	0.000	0.005
Grays Harbor Hatchery	SCBC.TROLL	0.004	0.000	0.000	0.004	0.010	0.000	0.000	0.010
Grays Harbor Hatchery	NWVI.TROLL	0.041	0.000	0.000	0.041	0.050	0.000	0.000	0.050
Grays Harbor Hatchery	SWVI.TROLL	0.040	0.000	0.000	0.040	0.090	0.000	0.000	0.090
Grays Harbor Hatchery	JOHNSTONE.NET	0.001	0.000	0.000	0.001	0.090	0.000	0.000	0.091
Grays Harbor Hatchery	JDF.NET	0.002	0.000	0.000	0.002	0.093	0.000	0.000	0.093
Grays Harbor Hatchery	JDF.SPORT	0.004	0.000	0.000	0.004	0.097	0.000	0.000	0.097
Grays Harbor Hatchery	WCVI.SPORT	0.001	0.000	0.000	0.001	0.098	0.000	0.000	0.098
Grays Harbor Hatchery	AREA.4B-5-6C.NET	0.005	0.000	0.000	0.005	0.103	0.000	0.000	0.103
Grays Harbor Hatchery	AREA.5-6.SPORT	0.009	0.000	0.000	0.008	0.113	0.000	0.000	0.111
Grays Harbor Hatchery	GRAYS.HARBOR.ESTUARY.NET	0.264	0.000	0.000	0.265	0.377	0.000	0.000	0.375
Grays Harbor Hatchery	COLRIV.MOUTH.TROLL	0.006	0.000	0.000	0.006	0.383	0.000	0.000	0.381

Exploitation Rates by Stock and Fishery – continued from previous page

Stock	Fishery ¹	Fishery Specific ER				Cumulative ER			
		Mark	Unmark	Wild	Base	Mark	Unmark	Wild	Base
Columbia River-Late	SWVI.TROLL	0.023	0.029	0.029	0.023	0.028	0.035	0.035	0.028
Columbia River-Late	JDF.NET	0.004	0.005	0.005	0.004	0.033	0.040	0.040	0.033
Columbia River-Late	JDF.SPORT	0.003	0.005	0.005	0.003	0.035	0.044	0.043	0.035
Columbia River-Late	AREA.4B-5-6C.NET	0.001	0.001	0.001	0.001	0.037	0.045	0.045	0.037
Columbia River-Late	AREA.5-6.TROLL	0.001	0.001	0.001	0.001	0.037	0.046	0.046	0.037
Columbia River-Late	AREA.5-6.SPORT	0.014	0.005	0.005	0.008	0.051	0.051	0.051	0.046
Columbia River-Late	AREA.9.SPORT	0.001	0.000	0.000	0.001	0.052	0.051	0.051	0.046
Columbia River-Late	COLRIV.MOUTH.TROLL	0.016	0.021	0.021	0.016	0.069	0.071	0.071	0.062
Columbia River-Late	COLRIV.MOUTH.SPORT	0.059	0.015	0.015	0.061	0.127	0.086	0.086	0.123
Columbia River-Late	AREA.2.TROLL	0.009	0.012	0.012	0.009	0.137	0.098	0.098	0.132
Columbia River-Late	WA.AREA.2.SPORT	0.090	0.025	0.025	0.037	0.227	0.123	0.123	0.169
Columbia River-Late	WA.AREA.3.TROLL.&SPORT	0.004	0.005	0.005	0.004	0.230	0.128	0.127	0.172
Columbia River-Late	WA.AREA.4/4B.TROLL	0.006	0.007	0.007	0.006	0.237	0.135	0.135	0.179
Columbia River-Late	WA.AREA.4.SPORT	0.004	0.001	0.001	0.001	0.241	0.136	0.136	0.180
Columbia River-Late	COLRIVER.EARLY.AND.YB.NET	0.034	0.053	0.053	0.034	0.275	0.189	0.189	0.214
Columbia River-Late	COLRIVER.LATE.NET	0.257	0.273	0.273	0.258	0.532	0.462	0.462	0.473
Columbia River-Late	BUOY.10.SPORT	0.061	0.018	0.018	0.064	0.593	0.480	0.480	0.537
Columbia River-Late	TILLAMOOK.&.EST.SPORT	0.006	0.001	0.001	0.009	0.599	0.482	0.481	0.546
Columbia River-Late	NWPRT.&.EST.SPORT	0.013	0.003	0.003	0.019	0.611	0.485	0.484	0.566
Columbia River-Late	COOS.BAY.&.EST.SPORT	0.018	0.005	0.005	0.027	0.629	0.489	0.488	0.593
Columbia River-Late	TILLAMOOK.TROLL	0.017	0.007	0.007	0.025	0.646	0.496	0.495	0.618
Columbia River-Late	NEWPORT.TROLL	0.019	0.007	0.007	0.029	0.665	0.503	0.503	0.646
Columbia River-Late	COOS.BAY.TROLL	0.019	0.007	0.007	0.027	0.684	0.511	0.511	0.674
Columbia River-Late	CALIF.KMZ.ALL	0.013	0.005	0.005	0.013	0.696	0.516	0.516	0.686
Columbia River-Late	CALIF.FTB/SOCAL.ALL	0.016	0.005	0.005	0.017	0.713	0.520	0.520	0.703
Columbia River-Late	BROOKINGS.SPORT	0.003	0.002	0.002	0.005	0.716	0.522	0.521	0.709
Columbia River-Late	GRAYS.HARBOR.ESTUARY.SPORT	0.003	0.001	0.001	0.002	0.719	0.522	0.522	0.710
Columbia River-Late	TERMINAL	0.181	0.307	0.308	0.100	0.900	0.830	0.830	0.810
Oregon Coast	NBC.TROLL	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Oregon Coast	SCBC.TROLL	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Oregon Coast	NWVI.TROLL	0.003	0.005	0.005	0.003	0.005	0.006	0.007	0.005
Oregon Coast	SWVI.TROLL	0.010	0.016	0.016	0.008	0.015	0.023	0.023	0.013
Oregon Coast	JDF.SPORT	0.002	0.003	0.003	0.002	0.018	0.026	0.026	0.015
Oregon Coast	WCVI.SPORT	0.002	0.003	0.003	0.002	0.019	0.029	0.029	0.016
Oregon Coast	AREA.5-6.SPORT	0.005	0.002	0.002	0.002	0.024	0.030	0.031	0.018
Oregon Coast	QUILLAYUTE.RIVER.NET	0.001	0.001	0.001	0.001	0.025	0.032	0.032	0.019
Oregon Coast	COLRIV.MOUTH.TROLL	0.013	0.018	0.018	0.010	0.037	0.050	0.051	0.029
Oregon Coast	COLRIV.MOUTH.SPORT	0.008	0.003	0.003	0.008	0.045	0.053	0.053	0.036
Oregon Coast	AREA.2.TROLL	0.002	0.002	0.002	0.001	0.047	0.055	0.056	0.038
Oregon Coast	WA.AREA.2.SPORT	0.010	0.003	0.003	0.003	0.056	0.059	0.059	0.041
Oregon Coast	WA.AREA.4/4B.TROLL	0.002	0.004	0.004	0.002	0.058	0.063	0.063	0.042
Oregon Coast	COLRIVER.EARLY.AND.YB.NET	0.001	0.001	0.001	0.000	0.059	0.064	0.064	0.043
Oregon Coast	BUOY.10.SPORT	0.014	0.006	0.006	0.011	0.073	0.069	0.070	0.054
Oregon Coast	TILLAMOOK.&.EST.SPORT	0.010	0.004	0.004	0.015	0.085	0.073	0.073	0.070

Exploitation Rates by Stock and Fishery - continued from previous page

Stock	Fishery ¹	Fishery Specific ER				Cumulative ER			
		Mark	Unmark	Wild	Base	Mark	Unmark	Wild	Base
Chehalis Hatchery	JDF.NET	0.008	0.008	0.000	0.008	0.156	0.162	0.000	0.158
Chehalis Hatchery	JDF.SPORT	0.005	0.006	0.000	0.006	0.162	0.168	0.000	0.164
Chehalis Hatchery	WCVI.SPORT	0.001	0.002	0.000	0.002	0.163	0.169	0.000	0.165
Chehalis Hatchery	AR.10.NET	0.002	0.002	0.000	0.002	0.165	0.172	0.000	0.167
Chehalis Hatchery	AREA.4B-5-6C.NET	0.009	0.009	0.000	0.009	0.174	0.181	0.000	0.176
Chehalis Hatchery	AREA.6/6A/7/7A.NET	0.002	0.002	0.000	0.002	0.176	0.183	0.000	0.178
Chehalis Hatchery	AREA.5-6.SPORT	0.018	0.004	0.000	0.014	0.194	0.187	0.000	0.193
Chehalis Hatchery	GRAYS.HARBOR.ESTUARY.NET	0.212	0.219	0.000	0.215	0.407	0.406	0.000	0.408
Chehalis Hatchery	COLRIV.MOUTH.TROLL	0.009	0.009	0.000	0.009	0.415	0.415	0.000	0.417
Chehalis Hatchery	COLRIV.MOUTH.SPORT	0.003	0.000	0.000	0.004	0.418	0.415	0.000	0.420
Chehalis Hatchery	AREA.2.TROLL	0.004	0.005	0.000	0.004	0.422	0.420	0.000	0.424
Chehalis Hatchery	WA.AREA.2.SPORT	0.013	0.003	0.000	0.006	0.435	0.423	0.000	0.430
Chehalis Hatchery	WA.AREA.4/4B.TROLL	0.008	0.009	0.000	0.008	0.444	0.432	0.000	0.438
Chehalis Hatchery	WA.AREA.4.SPORT	0.020	0.005	0.000	0.007	0.464	0.436	0.000	0.446
Chehalis Hatchery	COLRIVER.LATE.NET	0.001	0.001	0.000	0.001	0.465	0.438	0.000	0.447
Chehalis Hatchery	BUOY.10.SPORT	0.009	0.002	0.000	0.009	0.474	0.439	0.000	0.457
Chehalis Hatchery	WA.GH.FW.NET	0.239	0.246	0.000	0.242	0.713	0.685	0.000	0.699
Chehalis Hatchery	TILLAMOOK.&.EST.SPORT	0.002	0.000	0.000	0.004	0.714	0.685	0.000	0.702
Chehalis Hatchery	NWPRT.&.EST.SPORT	0.002	0.000	0.000	0.002	0.716	0.686	0.000	0.704
Chehalis Hatchery	COOS.BAY.&.EST.SPORT	0.001	0.000	0.000	0.001	0.717	0.686	0.000	0.705
Chehalis Hatchery	TILLAMOOK.TROLL	0.001	0.000	0.000	0.002	0.718	0.686	0.000	0.707
Chehalis Hatchery	GRAYS.HARBOR.ESTUARY.SPORT	0.019	0.005	0.000	0.013	0.737	0.692	0.000	0.720
Chehalis Hatchery	TERMINAL	0.023	0.028	0.000	0.000	0.760	0.720	0.000	0.720
Willapa	NBC.TROLL	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
Willapa	SCBC.TROLL	0.001	0.001	0.001	0.001	0.007	0.007	0.007	0.007
Willapa	NWVI.TROLL	0.048	0.050	0.050	0.047	0.055	0.058	0.058	0.054
Willapa	SWVI.TROLL	0.116	0.122	0.121	0.114	0.171	0.179	0.180	0.169
Willapa	JOHNSTONE.NET	0.001	0.001	0.001	0.001	0.172	0.180	0.180	0.170
Willapa	JDF.NET	0.003	0.003	0.003	0.003	0.175	0.183	0.184	0.173
Willapa	WCVI.SPORT	0.005	0.006	0.006	0.005	0.180	0.189	0.189	0.178
Willapa	AREA.5-6.SPORT	0.005	0.001	0.001	0.004	0.185	0.191	0.191	0.181
Willapa	COLRIV.MOUTH.TROLL	0.007	0.008	0.009	0.007	0.193	0.199	0.199	0.189
Willapa	COLRIV.MOUTH.SPORT	0.013	0.003	0.003	0.013	0.206	0.202	0.203	0.203
Willapa	AREA.2.TROLL	0.003	0.004	0.004	0.003	0.209	0.206	0.206	0.206
Willapa	WA.AREA.2.SPORT	0.032	0.009	0.009	0.013	0.242	0.214	0.215	0.219
Willapa	WA.AREA.3.TROLL.&SPORT	0.003	0.003	0.004	0.003	0.245	0.217	0.218	0.222
Willapa	WA.AREA.4/4B.TROLL	0.016	0.017	0.017	0.016	0.260	0.234	0.234	0.237
Willapa	WA.AREA.4.SPORT	0.007	0.002	0.002	0.003	0.267	0.235	0.236	0.239
Willapa	BUOY.10.SPORT	0.013	0.003	0.003	0.014	0.280	0.239	0.239	0.253
Willapa	TILLAMOOK.&.EST.SPORT	0.003	0.001	0.001	0.006	0.283	0.240	0.240	0.258
Willapa	NWPRT.&.EST.SPORT	0.010	0.002	0.002	0.016	0.294	0.242	0.242	0.274
Willapa	COOS.BAY.&.EST.SPORT	0.006	0.001	0.001	0.010	0.300	0.243	0.243	0.283
Willapa	TILLAMOOK.TROLL	0.009	0.004	0.004	0.013	0.308	0.247	0.247	0.296
Willapa	NEWPORT.TROLL	0.012	0.005	0.005	0.018	0.321	0.252	0.252	0.315

Table 7: Percent of stock subgroups caught by treaty fishers.

Stock	Proportions Treaty		
	Hatchery	Wild	Total
Nooksack/Samish	0.50	0.51	0.50
Skagit	0.33	0.57	0.50
Stillaguamish/Snohomish	0.46	0.53	0.50
South Sound	0.45	0.72	0.50
Hood Canal	0.50	0.76	0.55
Juan de Fuca	0.21	0.82	0.39
Makah	0.50	0.50	0.50
Hoh	0.00	0.50	0.50
Quilayute	0.50	0.51	0.50
Queets	0.70	0.76	0.73
Quinault	0.76	0.81	0.78
Grays Harbor	0.48	0.61	0.53
Columbia River-Early	0.17	0.49	0.19
Columbia River-Late	0.25	0.75	0.26

Table 8: Proportion of fishery catch caught by treaty fishers.

Fishery	Catch	Proportion Treaty
ALL.AK.TROLL	910	0.00
NK/SAMISH.MARINE.NET.8	391	0.52
NK/SAMISH.MARINE.NET.9	15550	0.26
NK/SAMISH.MARINE.NET.10-12	25567	0.54
SKAGIT.MAR.& FW.NET.8	639	0.52
SKAGIT.MAR.& FW.NET.9	1664	0.53
SKAGIT.MAR.& FW.NET.10-12	1420	0.54
STL/SNO.MARINE.NET.9	40861	0.46
STL/SNO.MARINE.NET.10-12	19466	0.48
AR.10.NET.9	89477	0.57
AR.10.NET.10-12	45869	0.59
AREA.4B-5-6C.NET.7	2517	1.00
AREA.4B-5-6C.NET.8	8923	1.00
AREA.4B-5-6C.NET.9	7953	1.00
AREA.4B-5-6C.NET.10-12	4133	1.00
AREA.5-6.TROLL.7	15	1.00
AREA.5-6.TROLL.8	904	1.00
AREA.5-6.TROLL.9	3122	1.00
AREA.6/6A/7/7A.NET.8	150	0.00
AREA.6/6A/7/7A.NET.9	9240	1.00
AREA.6/6A/7/7A.NET.10-12	1857	0.00
AREA.5-6.SPORT.1-5&6	1385	0.00
AREA.5-6.SPORT.7	22945	0.00
AREA.5-6.SPORT.8	47133	0.00
AREA.5-6.SPORT.9	30893	0.00
AREA.5-6.SPORT.10-12	2678	0.00
AREA.7.SPORT.9	50	0.00
AREA.8.SPORT.1-5&6	27	0.00
AREA.8.SPORT.7	2664	0.00
AREA.8.SPORT.8	1092	0.00
AREA.8.SPORT.9	1687	0.00
AREA.8.SPORT.10-12	108	0.00
AREA.9.SPORT.1-5	185	0.00
AREA.9.SPORT.6	2280	0.00
AREA.9.SPORT.7	4842	0.00
AREA.9.SPORT.8	4031	0.00

Fishery	Catch	Proportion Treaty
BUOY.10.SPORT.10-12	5781	0.00
WA.GH.FW.NET.10-12	75829	1.00
TILLAMOOK.&.EST.SPORT.6	845	0.00
TILLAMOOK.&.EST.SPORT.7	9639	0.00
TILLAMOOK.&.EST.SPORT.8	2223	0.00
TILLAMOOK.&.EST.SPORT.9	226	0.00
NWPRT.&.EST.SPORT.1-5	33	0.00
NWPRT.&.EST.SPORT.6	5736	0.00
NWPRT.&.EST.SPORT.7	26320	0.00
NWPRT.&.EST.SPORT.8	1156	0.00
COOS.BAY.&.EST.SPORT.1-5	258	0.00
COOS.BAY.&.EST.SPORT.6	10035	0.00
COOS.BAY.&.EST.SPORT.7	28670	0.00
COOS.BAY.&.EST.SPORT.8	5722	0.00
COOS.BAY.&.EST.SPORT.9	138	0.00
TILLAMOOK.TROLL.7	32960	0.00
NEWPORT.TROLL.6	22990	0.00
NEWPORT.TROLL.7	13109	0.00
COOS.BAY.TROLL.6	14153	0.00
COOS.BAY.TROLL.7	27793	0.00
ALL.AK.NET	115	0.00
CALIF.KMZ.ALL.6	14284	0.00
CALIF.KMZ.ALL.7	10315	0.00
CALIF.KMZ.ALL.8	153	0.00
CALIF.KMZ.ALL.9	725	0.00
CALIF.FTB/SOCAL.ALL.1-5	424	0.00
CALIF.FTB/SOCAL.ALL.6	36703	0.00
CALIF.FTB/SOCAL.ALL.7	19714	0.00
CALIF.FTB/SOCAL.ALL.8	1967	0.00
QUEETS.RIVER.NET.9	4902	1.00
QUEETS.RIVER.NET.10-12	6281	1.00
QUINAULT.RIVER.NET.8	122	1.00
QUINAULT.RIVER.NET.9	11518	1.00
QUINAULT.RIVER.NET.10-12	11892	1.00
BROOKINGS.SPORT.6	4477	0.00
BROOKINGS.SPORT.7	4076	0.00
BROOKINGS.SPORT.8	135	0.00

Table 9: True PEFs versus estimated PEFs. Assumes complete double index marking.

Stock	Sub-stock	True PEF	Mean PEF ¹
Georgia Strait-Mainland	marked subgroup	1.00	0.97
Nooksack/Samish	marked subgroup	1.00	0.99
Stillaguamish/Snohomish	marked subgroup	4.29	4.30
South Sound	marked subgroup	24.22	24.25
Georgia Strait-Vancouver Island	marked subgroup	1.00	1.01
North Coast British Columbia	marked subgroup	1.00	1.00
Queets	marked subgroup	1.00	0.99
Quinault	marked subgroup	1.00	1.01
Grays Harbor	marked subgroup	8.43	8.44
Columbia River-Early	marked subgroup	25.89	25.90
Columbia River-Late	marked subgroup	36.55	36.53
Oregon Coast	marked subgroup	14.73	14.72
Oregon Aqua-culture	marked subgroup	28.47	28.36
California	marked subgroup	1.37	2.66
NW Vancouver Island	marked subgroup	1.01	0.88
Willapa	marked subgroup	36.42	36.42
Georgia Strait-Mainland	unmarked subgroup	57.73	57.73
North AK In/Out	unmarked subgroup	129.08	120.88
Nooksack/Samish	unmarked subgroup	20.35	20.35
Skagit Wild	unmarked subgroup	12.27	12.24
Stillaguamish/Snohomish	unmarked subgroup	40.91	40.92
South Sound	unmarked subgroup	7.70	7.70
Georgia Strait-Vancouver Island	unmarked subgroup	4.86	4.86
North Coast British Columbia	unmarked subgroup	115.89	115.78
Queets	unmarked subgroup	9.48	9.47
Quinault	unmarked subgroup	12.73	12.73
Grays Harbor	unmarked subgroup	10.43	10.43
Columbia River-Early	unmarked subgroup	2.42	2.42
Columbia River-Late	unmarked subgroup	2.97	2.98
Oregon Coast	unmarked subgroup	8.75	8.79
Oregon Aqua-culture	unmarked subgroup	1.00	1.04
California	unmarked subgroup	24.65	26.68
NW Vancouver Island	unmarked subgroup	136.82	137.00
Willapa	unmarked subgroup	2.97	2.97
Queen Charlotte Island	unmarked subgroup	112.27	112.28

¹Average of 100 iterations